CHARACTERIZATION OF CATTLE MILK AND MEAT PRODUCTION, PROCESSING AND MARKETING SYSTEM IN METEMA DISTRICT, ETHIOPIA.

M.Sc. THESIS

TESFAYE MENGSITIE DORE

HAWASSA UNIVERSITY, AWASSA

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CHARACTERIZATION OF CATTLE MILK AND MEAT PRODUCTION, PROCESSING AND MARKETING SYSTEM IN METEMA DISTRICT, ETHIOPIA.

TESFAYE MENGSITIE DORE

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APPROVAL SHEET- 1

This is to certify that the thesis entitled “Characterization of cattle milk and meat production, processing and marketing system in Metema district, Ethiopia”, Submitted in partial fulfillment of the requirements for the degree of Master of Science in Animal Sciences with a specialization of Dairy Science of the Graduate Program of the Department of Animal and Range Sciences, Awassa College of Agriculture, and is a record of original research carried out by Tesfaye Mengsitie Dore, I.D.No AWR/3006/97 under my supervision, and no part of the thesis has been submitted for any other degree or diploma.

The assistance and the help received during the course of this investigation have been duly acknowledged. Therefore, I recommend that it will be accepted as fulfilling the thesis requirements.

_____	_____	_____
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_____	_____	_____
Name of Main Advisor	Date	Signature
_____	_____	_____
Name of Internal Examiner	Date	Signature
_____	_____	_____
Name of External Examiner	Date	Signature

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DECLARATION

I declare that this thesis is my original work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillments of the requirements for M.Sc. degree at Hawassa University and is placed at the University library to be made available to borrowers under rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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LISTS OF ABBREVIATIONS

AAPBMDA	Animal, Animal Products and By-products Market Development Authority
ACBIR	Andassa Cattle Breeding and Improvement Ranch
CI	Calving interval
AFC	Age at first calving
AFS	Average family size
AI	Artificial insemination
ANOVA	Analysis of variance
BOA	Bureau of Agriculture
CACC	Central Agricultural Census Commission
CBFS	Cotton based farming system
CC	Calf crop
CI	Calving interval
CSA	Central Statistics Authority
DDE	Dairy Development Enterprise of Ethiopia
DMY	Daily Milk Yield
EJAP	Ethiopian Journal of Animal Production
ESAP	Ethiopian Society of Animal Production
E.B	Ethiopian Currency, where 1 USD equals to 8.75 Birr.
E.C	Ethiopian calendar
FAO	Food and Agricultural Organization of the United Nations
FAOSTAT	Food and Agricultural Organization of the United Nations statistics
FMD	Foot and Mouth Disease

GDP	Gross Domestic Product
GLM	General Linear Model
Ha	Hectare
HF	Holstein Friesian
HHC	Household count
HH	Household
HHs	Households
HU	Hawassa University
ILCA	International Livestock Centre for Africa
ILRI	International Livestock Research Institute
ILDP	Integrated livestock development project
IPMS	Improving Productivity and Market Success of Ethiopian farmers
LL	Lactation length
LSD	Lumpy Skin Disease
LY	Lactation yield
M.a.s.l.	Meter above sea level
NSC	Number of services per conception
MEDAC	Ministry of Economic Development and Cooperation
MDOA	Metema district office of Agriculture
MOA	Ministry of Agriculture
No	Number
PRA	Participatory Rural Appraisal
RMA	Rapid Marketing Appraisal

SBFS	Sesame based farming system
SE	Standard error
SPSS	Statistical package for social sciences
SSA	Sub-Saharan Africa
WA	Weaning age

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Characterization of cattle milk and meat production, processing and marketing system in Metema district, Ethiopia.

By Tesfaye Mengsitie (B.Sc. in Animal Science, HU)
Major advisor- Fekadu Beyene (Professor, Dairy Technology, HU)
Co-advisors - Azage Tegegne (PhD, Senior Animal Scientist, ILRI)
- Berhanu GebreMedhin (PhD, Agricultural Economics, ILRI)

ABSTRACT

A study on characterization of cattle milk and meat production, processing and marketing system was conducted in Metema district based on data collected between September and October, 2006. A multistage sampling procedure was employed to select representative kebles and households from CBFS, SBFS and Gendawuha town. A total of 270 households were randomly selected using systematic random sampling method. Questionaire based formal survey as well as PRA techniques were employed to collect both quantitative and qualitative data on cattle milk and meat production and processing systems in the district, while RMA techniques were used to characterize the marketing system of dairy products, meat and live cattle. In addition, 30 households were voluntarily selected from the two rural farming systems and were continually monitored to collect quantitative data on milk and other dairy products produced per household. Accordingly, the latter data were used to corroborate the survey based information on related parameters. Two types of livestock production systems were identified in the district, namely crop-livestock mixed farming, which is exercised by resident farmers, and transhumance production system practiced by seasonally in fluxing farmers from neighboring highlands. The current study was concerned entirely on the former production system type. The average cattle herd size of households was 15.53 heads, but it varied significantly ($P<0.05$) among the three areas. Cows (30.45%) and calves (32.29%) mainly dominate the herd composition, while heifers (13.90%), oxen (12.02%) and bullocks (10.30%) represented minor proportions. Cattle type (Zebu) locally called Agew, Simada and Fogera were dominantly found in the district, although some cattle types introduced from neighboring countries known as "Ruthana" and "Felata" cattle were observed in minor proportions. Where as introduced temperate breeds were entirely lacking in the district. The breeding system was entirely natural mating. 65.8% of the interviewed farmers practiced selective mating, while the rest one-third left their cows for open mating with no concern for selecting the best bull, although some variation exist from area to area. Major feed resources used by the households were natural grazing (31.0%), crop residues (29.5%), crop aftermath (21.8%) and hay (17.8%). The available vast communal range lands provide high potential for conserving excess fodder during the wet season in the form of hay. Despite this, households make insignificant quantity of hay and face critical feed shortage during the dry season. Critical shortage of water was also noted during the dry season, particularly in highly arid lowlands. Three types of diseases were identified as the major health problem of cattle and these included tick infestation (37.2%), babesiosis (31.6%) and FMD (15.6%). Average milk off-take of indigenous cows was 1.9±0.045 liter/cow/day and on average cows gave a lactation yield of 324.0± 10.274 liters/cow during an average lactation period of about 5.9±0.14 months. Cows in Gendawuha town gave significantly higher daily milk yield as well as were milked for longer lactation period than in the two rural areas. As a result, the lactation yield

was significantly higher in the former than in the latter areas and these differences were mainly attributed to better feeding (supplementation) and management provided for the cows in the town. Overall, mean CI was 17.97±0.313 months, but it was significantly higher in the town than in the rural areas because of extended lactation. Mean AFC of cows in Metema was quite late (4.54±0.05 years) even by local standard. Out of the total milk produced, most of it was processed (63%), while some quantity was consumed with in the household (18%) and used for calf rearing (13%). On the other hand, most of the butter was consumed with in the household (58 %), while small proportion was sold out (25%). In general, the market share of whole milk and other milk derivatives (cottage cheese, butter milk and fermented milk) was almost negligible, while butter was comparatively the most marketable commodity in all the three areas. The dairy marketing system identified in the study area was entirely informal marketing system. Churning methods includes churning by placing the churner on the floor, hanging the churner on tripods and churner is shacked with both hands. Cattle fattening experience was not developed well, because of lack of experience (34.9%), shortage of labor (30.8%), feed shortage during dry season (17.5%) and shortage of capital (15.9%). Out of the total fresh meat produced, 49.8 % was consumed by the household in the form of fresh, while 50.2% was retained for processing. Milk and meat production and marketing system were constrained by theft of cattle, infectious and parasitic disease, lack of milk processing services, poor market information on the price and supply condition, lack of services (extension, inputs, and veterinary) and lack of feed processing and utilization management. Extension intervention should focus on dairy and meat production and processing as well as on improving the marketing system of these products.

Key words: Dairy, beef, production system, marketing, processing, utilization.

1. INTRODUCTION

Livestock products are appealing and convenient sources of nutrients. Protein and micro nutrient deficiencies remain widespread in developing countries because people subsist on diets that are almost entirely made of starchy staples. The addition of milk and meat provides protein, calcium, vitamins, and other nutrients that are lacking in diets, which are exclusively made up of staples such as cereals.

Livestock perform multiple functions in the Ethiopian economy by providing food, input for crop production and soil fertility management, raw material for industry, cash income as well as in promoting saving, fuel, social functions, and employment. Various estimates show that the livestock sub-sector contributes 12–16% of the total and 30–35% of agricultural GDP, respectively (MEDAC, 1998; AAPBMDA, 1999). The contribution of dairy products to the gross value of livestock production is not well known but in peri-urban areas of Ethiopia, about 20% of average income was derived from dairy products (Win rock International, 1992). More over, previous research result showed that sales of dairy products, especially butter, contribute to 20% of the rural household income in the Ethiopian highlands (ILCA, 1989). Nevertheless, the production of milk for human food is often the primary reason for keeping livestock by pastoralists to meet their subsistence needs in arid and semi-arid regions and by urban and peri-urban smallholder farmers as a source of income from milk sales.

According to Nell (1992), dairying in smallholder farmers is a biologically efficient system, which converts large quantities of low-grade roughage to milk. It is to a certain extent a more efficient and intensive system, in terms of nutrients and protein production for human

consumption from a given area or quantity of feed, than beef farming. Nell (1992) added his idea that milk production is a continuous production process and requires a continuous supply of feed of consistently good quality. Interruption of feed supply even for a short period causes a marked decrease in milk yield during the remaining part of the lactation. Beef production, on the other hand, is a non-continuous process and is often better adapted to the seasonal fluctuations that are so common in sub-Saharan Africa (Nell, 1992). As Walshe *et al.* (1991) pointed out, where there is access to a market, dairying is preferred to meat production since it makes more efficient use of feed resources and provides a regular income to the producer. It is also more labor intensive and supports substantial employment in production, processing and marketing (Leeuw *et al.*, 1999).

Although considerable variation is noted among existing estimates of livestock population, the latest estimates indicated that Ethiopia has the largest livestock population and the highest draft animal population in Africa. There are about 38.1 million cattle, 26.2 million sheep and goats, 5.5 million equine, 0.46 million camels, 35.6 million chickens and 4.2 million beehives in the country (FAOSTAT, 2004). Despite its huge numbers, the livestock sub-sector in Ethiopia is not productive as compared to its high population potential, and the direct contribution to the national economy is very limited. The poor genetic potential, in combination with the sub-optimal management situation that the animals are exposed to are the main contributors to the observed low productivity.

Demand for animal products in Sub-Saharan Africa and generally in the developing countries is likely to rise significantly as a result of population growth, urbanization and rising income in

the face of relatively low levels of consumption at present (Agajie *et al.*, 2002). Because of the growing demand for dairy products, farmers need to be motivated to produce more. However under the present situation, poor marketing system and price structure are the major constraints to improve rural milk production (Tsehay, 1998).

Ethiopia is not self-sufficient in milk and a considerable amount of foreign exchange has to be spent on the import of dairy products. Per capita consumption of milk is low in Ethiopia (17kg) and Tanzania (22kg) compared with Kenya (80kg) and the average for Africa (26kg) (Gebre Wold *et al.*, 2000). The low per capita consumption of milk in Ethiopia and Tanzania is partly due to the predominance of the low milk producing zebu cattle with production level of about 200-250 kg per annum.

Total milk production in Ethiopia is estimated to be 1.19 million metric tons with the contribution of milking cows (81.2%), does (7.9%), ewes (4.6%) & female camels (6.3%) (MOA, 1999). Despite the huge potential that the country posses for increased milk production that can even be stretched to quantities beyond its domestic needs, there is a chronic shortage of the product in most part of the country arising mainly from insufficient production coupled with inhibitive cultural taboos related to consumption and absence of processing facilities and marketing infrastructure.

Generally, livestock productivity in Ethiopia is very poor in all characteristics of economic importance as compared to Eastern and Southern African countries. The cattle industry, in particular as producer of meat and milk, is very poor (ILCA, 1993).

It was clearly stated by different authors that livestock plays a vital role in improving the nutritional status of the ever-increasing urban population, general substantial income and create job opportunities through the process of production, processing and marketing of dairy products. However, information is meager to indicate the general picture of the production system, mainly characteristics of the dairy farms and herd structure. According to Azage (2001), the major national concern in the development of the livestock sector is to improve milk production. However, systematic & exhaustive studies on the milk yield potential of the indigenous breeds are not available.

Moreover, according to Staal and Shapiro (1996), the smallholder dairy farmers living in the villages contribute 97% of the total national milk production of Ethiopia. Therefore, improvement of the sector is imperative for better production and supply of the products to the consumers. However, current knowledge on market structure, performance and prices is poor and inadequate for designing policies and institution to overcome perceived problems in the marketing system (Ayele *et al*., 2003).

In Amhara region, dairying is nearly always part of mixed farming systems. Aklilu (2004) revealed that the majority of total milk production in Amhara region takes place in the high land areas of the region, where exotic and crossbred dairy cattle are kept. Even though there were small ruminants and camel, cows continue to be the only source of milk and milk products in Amhara region. Rural, peri-urban and urban milk production systems were common in the region. In these production systems, fresh milk, naturally fermented milk (Ergo), butter, ghee and ayib are the types of dairy products produced (Aklilu, 2004). Milk

was seldom sold in many parts of the Amhara region due to cultural taboos and milk production was mainly aimed at subsistence consumption.

Metema is one of the districts of North Gondar Zone of the Amhara Regional State. In Metema district cattle were the dominant livestock species (56.57%), followed by goats (22.74%), chicken (13.23%), sheep (4.11%), donkey (3.22%) and camel (0.1%). The smallholder mixed crop-livestock production system being practiced in Metema district involved entirely indigenous cattle type, composed of small (< 5 cows/HH), medium (5-10 cows/HH), and large (> 10 cows/HH) herd size of cows, in which the respective category comprises 56.9%, 36.0%, and 7.1% of the farms, respectively. The rainy season transhumance cattle production system is also a common phenomenon practiced by the highlanders of North Gondar zone. Livestock in the study area, in general, provides multiple functions (milk, draft, meat & cash sources).

Despite its considerable roles, little has been known so far about the role of cattle production in Metema, as well as processing and marketing of cattle products. On the other hand, evaluation of the prevailing production system and identification of the limitations in production and marketing of cattle milk and meat would assist to design appropriate improvement strategies. Such a study is limited for livestock production of Amhara region and particularly unavailable for Metema area because Metema area is located quite far from the capital town Addis Ababa (925 km) and regional town Bahir Dar (360 km). This study was therefore, carried-out to assess production, processing and marketing system of cattle milk and

meat, identify major constraints and suggest appropriate area of intervention for improvement of cattle husbandry in Metema district. The objectives of the study were stated as follows.

Objectives:

1. To characterize the existing cattle milk and meat production systems practiced in the study area.
2. To describe the current milk and meat marketing system in the study area.
3. To investigate milk and meat processing methods & materials used in the study area.
4. To assess the constraints of milk and meat production and marketing system and recommend possible intervention mechanism to mitigate the problems.

2. LITERATURE REVIEW

2.1. Dairy production system in the tropics

Dairy production systems in the tropics are concentrated near consumption centers. It is no coincidence that cattle and rural human population densities are highly correlated with specialized smallholder (large-scale) dairy farms generally located close to (peri-urban) or with in (intra-urban) major markets, or more distant when there is an efficient market infrastructure (Kruska *et al*., 1997). On the Other hand, the systems of production and their productivity are influenced by agro-ecological factors and traditional consumption habits (Leeuw *et al*., 1999).

2.1.1. Dairy production in Sub-Saharan Africa (SSA)

Dairy production in sub-Saharan Africa (SSA) can be categorized into traditional and improved production systems. The traditional system includes subsistence, pastoralist and agro pastoralist systems. The improved production system includes intensive smallholder systems and urban/peri-urban, semi-intensive/intensive dairying systems (Debrah, 1992).

According to Debrah and Berhanu (1991), despite milk's contribution to gross domestic product and its value as a food, sub-Saharan Africa has failed to attain self-sufficiency in dairy production. The region has, therefore, depended on dairy imports (commercial and food aid) to satisfy rising domestic demand.

2.1.2. Factors limiting tropical milk production

i. Breed factor

As compared to breeds originated from temperate areas, cattle breeds originate from the tropics generally have a limited genetic potential for milk production and remain mediocre

producers (500-1500 kg per lactation) even when the best possible husbandry conditions are available to them (Pagot, 1992). In a general way, the genetic improvement of local breeds for milk production has essentially been obtained by crossing with breeds, which originate from temperate countries (Pagot, 1992). However, the Tropical Africa indigenous breeds have special adaptive traits for disease resistance, heat tolerance and ability to utilize poor quality feed (Tedonkenk Pamo and Pieper, 2000).

ii. Feed resources

Inability to feed animals adequately throughout the year is the most widespread phenomenon. Dry- season feed supply is the paramount problem. The feed shortages and nutrient deficiencies are more acute in dry seasons (Tedonkenk Pamo and Pieper, 2000). The natural pastures of the tropics have significant seasonal variations of productivity and nutritive value. Pagot (1992) showed that modern agronomic techniques (selection of forage species, fertilization and irrigation) enable the attainment of productivity very much higher than the best obtained in temperate countries. The author added his idea that tropical climates are favorable to the production of abundant food energy notably in the form of starchy root crops, but the level of production of forage proteins is not high.

iii. Climatic factors

Numerous experiments have shown that a prolonged period in which temperatures are more than 25 ^{o}C, particularly in humid air conditions leads to a reduction of dry matter intake by milking cows and, as a consequence, a drop in their production. High ambient temperatures have another depressive action on milk production by reducing the fertility of the cows, thus lengthening the interval between lactations (Pagot, 1992).

The other similar study indicated that dairy cattle, like other warm-blooded animals, function most efficiently in environments where they can maintain their body temperature at a round 38°C. Tissue and cellular metabolism and the underlying biochemical reactions that sustain life and productive functions need body temperature to be maintained within very narrow limits. Relatively small increases in body temperature, for example, one degree celsius or less result in detectable and deleterious effects on metabolism and tissue integrity, in particular, the breakdown of body protein and a significant depression in production (Vercoe, 1999).

iv. Sociological factors

According to Pagot (1992) report, livestock herding peoples in the tropics are often nomadic or transhumant and do not practice agriculture. This system of production does not permit a place for intensive forage production and has limited possibilities for improvement. In general, sedentary stockmen are agriculturalists and rarely exploit their animals for milk, except when they are sedentary pastoralists.

v. Pathological factors

The most serious animal disease constraints to livestock productivity are the parasitic and viral diseases mainly vector-transmitted that have a wide geographic distribution and whose severities are strongly influenced by the environment (Tedonkenk Pamo and Pieper, 2000). The disease transmitted by ticks (babesiosis, anaplasmosis, heart water) have been the main justification, for a long time, of the crossing of Zebus with specialized European breeds for milk production. In improved methods of animal production (Zero grazing), the need to favor these practices is considerably reduced (Pagot, 1992). A research conducted at Metema area

indicated that LSD, Babesiosis, Trypanosomosis, Mastitis, and Entritis were the major cattle diseases, which contributed to decrease the productivity of livestock (Gizachew, 2007).

2.1.3. Overview of milk production system in Ethiopian

Most of the researchers used different approaches at different time for the classification of livestock/milk production system in Ethiopia. Beyene (2004) identified four major dairy production systems, namely: Smallholder dairy farming system in the crop-livestock mixed farming system in the highlands; Urban and peri-urban dairy system found around and inside the big cities; Pastoral/agro-pastoral system in the lowlands; Parastatal large-scale dairy farms. Moreover, he concluded that the production of milk in East African countries in general and in Ethiopia in particular is dominated by smallholder dairy production system.

Based on agro-ecology characterization of the area, socio-economic structures of the human population and the species of livestock and type of breed used for milk production, Getachew and Gashaw (2001) distinguished the Ethiopian milk production system in to five categories. These are traditional pastoral livestock farming, traditional highland mixed farming, the emerging smallholder dairy farming, urban and peri-urban dairy farming and specialized commercial intensive dairy farming.

According to Mekasha (1999), livestock/milk production system in sub-Saharan countries classified in to five systems based on a different approach (on farming systems, the principal ecological zones and the underlying livestock production systems), which are also applicable

to Ethiopia namely: Pastoralism, Agropastoralism, Mixed farming, Intensive dairy farming and Peri-urban milk production.

Based on climate, land-holding size and farming systems, four main dairy production systems are recognized in Ethiopia (Zegeye, 2003), namely: Pastoralism, Highland smallholder, Peri-urban and Urban.

2.1.3.1. Pastoralism

According to Zegeye (2003), pastoralism **a**s a system mainly operating in the rangelands where the peoples involved follow animal-based life styles, which requires of them to move from place to place seasonally based on feed and water availability. For food, pastoralists mainly depend on milk, and their accumulated wealth and savings are in the form of live animals. Milk production under the systems is strictly seasonal and range condition-dependent being surplus in the wet season and restricted in the dry season.

According to Getachew and Gashaw (2001), the lowland accounts for 27% of the milk produced. Because of the erratic rainfall pattern and related reasons, resulting in shortage of feed, milk production per unit is low and highly seasonal. More milk will be produced in the wet season where pastoralists would mostly conserve (in Borana as Ititu) and convert the surplus milk into butter, and trade off to the highlanders in the peripheral markets for grain. In the pastoral areas, milk production is the major activity as food and income source, where the livelihood of the semi-nomadic transhumance population is dependent on livestock (Coppock, 1994). The same author also identified that cattle dominate the population (55.4% of the TLU) followed by camel (15.3%), goats (13.7%) and sheep (6.4%).

2.1.3.2. Highland smallholder production system

Highland smallholder production system operates in most highlands of Ethiopia, with increasing population, there is an ever- decreasing share of pastureland for grazing; and with the corresponding increase in the cultivated area, there is a need to continuously produce more animal draught power. As a result, the rural farmers in these areas incorporate small-scale dairy production with crop farming with the objective of producing animal power (oxen) for tilling the land (Zegeye, 2003).

As reported by Getachew and Gashaw (2001), the highland area can be regarded as a mixed farming system, in which crop and livestock are interdependent. The highland smallholder milk production using indigenous cattle is the predominant milk production system. Though the majority of the system's of cattle and milk production are composed of the local Zebu, very few of the nation’s crossbred cattle are believed to account for much of the milk production in the mixed farming system. More over, similar author added his idea as cattle constituting 72.4% of the total TLU, out of which cows (28%) dominates the other herd composition. On the other hand, 40-45% of the cow’s populations are on milk each year (Getachew and Gashaw, 2001).

2.1.3.3. Urban milk production system

By the virtue of their location, producers are not expected to have access to agricultural or pasture land, as the operation takes place within cities and as a result, they are forced to buy their feed (Zegeye, 2003). Based on the scale and level of operations, this production system could be subdivided into small scale and large scale and used 100% zero grazing (Zegeye,

2003). Tsehay (2002) described that urban milk production system inside and around Addis Ababa consists of 5167 small, medium and large dairy farms producing about 35 million liters of milk annually. Out of the total volume of milk produced in and around Addis Ababa, 73%, 10%, 9.4%, 7.6% were marketed, left for HH consumption, goes to calves and processed in to butter and ayib (Ethiopian cottage cheese), respectively (Azage and Alemu, 1998).

Although some farmers produce good quality milk, hygienic quality and composition of most milk marketed in such production systems is poor (Tsehay, 2002). Moreover, price is high even when quality of milk is low. No standards and quality control mechanisms or dairy policy exist to safeguard consumers.

2.1.3.4. Peri-urban milk production system

Peri-urban dairy production system is mainly operational in areas where the population density is high, agricultural land is shrinking due to expanding urbanization, and labor cost is on the increase (Zegeye, 2003). Nell (1992) reported that Peri-urban dairy system occurs around cities, where demand for milk is high.

Peri-urban milk production system includes smallholders and commercial dairy farmers working in the proximity of the city of Addis Ababa and other regional towns. Most of the improved dairy stock in Ethiopia is used for this type of production system (Tsehay, 2002). However, contribution to the total domestic milk supply for Addis Ababa remained at only 14% (Belachew *et al*., 1994).

The producers may or may not hove access to cultivable or pastureland and some of them are usually left their few animals for grazing on the roadside. Animals they keep ranged from 50% crosses to high-grade Holestien Friesian (Zegeye, 2003). On the other hand, **t**he main sources of feed are agro-industrial byproducts (e.g. brewery waste and oilseed cakes), cultivated fodder crops and crop residues (Nell, 1992).

Urban and peri-urban dairy production system is an important component of livestock production system in Ethiopia (Yoseph *et al*., 2003). Urban and per-urban milk production has developed in and around major cities and towns, which have high demand for milk. The system comprised small and medium sized dairy farms using crossbred and high grade dairy cattle. Herd sizes are small due to urbanization (town dairy with usually less than 5 milking cows), land size limitations and economic capacity. Increasing demand for more and diversified dairy products, particularly in urban centers, will be a major driving force and a challenge for the development of peri-urban dairy production systems (Azage and Alemu, 1998). The substantial demand-supply variation in milk and milk products for the major urban centers in Ethiopia shows the untapped potential for the development and flourishing of peri-urban dairy farms. Large commercial and smallholder peri-urban dairy production systems have tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers (Azage and Alemu, 1998).

The former two production systems are the most predominant milk production system accounting for over 97% of total national milk production (Staal and Shapiro, 1996). These systems are based on low producing indigenous breeds of zebu cattle. Livestock are kept under

traditional management conditions and generally obtain most of their feed from native vegetation, aftermath grazing and crop residues. The systems are not market-oriented and most of the milk produced in it is retained for home consumption. The level of milk surplus is determined by the demand for milk of the household and its neighbors, the potential to produce milk in terms of herd size, production season and access to a nearby market. The surplus is mainly processed using traditional technologies and milk products such as butter, ghee, ayib and sour milk are usually marketed through the informal market after the households satisfy their needs (Tsehay, 2002).

In general, according to some investigation by the year 1985 and 1998 the total milk available, share of cow's milk and the share of imported milk from the total were summarized in Table 1.

Table 1: Total milk production and imports for Ethiopia, 1985 and 1998.

Milk availability and percentage	*Years*	
	1985	1998
Total milk availability ($\times 10^3$ tones)	1125	1170
Percentage of total milk availability		
Cows' milk	60.7%	80.1%
Milk of other species	19.6%	19%
Net imports	19.7%	0.9%

Source: Tambi *et al*. (2001)

2.1.4. Productive and reproductive performance under different production system

Milk yield

According to FAO (1993), the main source of milk in Ethiopia is the cow, constitute 83.4% of the total annual milk output. Zegeye (2003) also stated that cattle are the main source of milk

even though very little or no consideration given to improve their milk production capabilities. As a result, their genetic potential for milk production as seen at present is low. However, their adaptability and survival under the traditional management system is excellent when compared with the introduced exotic cattle species.

According to Lemma *et al*. (2005), average milk off-take of local Arsi cows was about 1.0 liter/head/day. Brokken and Senait (1992) reported that average daily yield of local cows was about 2 liters, compared with about 6 liters for crossbred cows. A study conducted at Holetta dairy farm indicated that average lactation yield and annual milk yield for Holestien Friesian cattle were 3357.9 Kg and 2783.1 kg, respectively (Mureja *et al.*, 2002). According to MOA (1997), it was indicated that productivity of indigenous cows is low and yield about 230 kg of milk per lactation. Research findings on Ethiopian indigenous cattle breeds indicated that milk yield ranged between 500 and 700 litters. Even under a research center management condition, average milk yield did not exceed 500 liters (Zelalem *et al*., 2006). The other research findings reported that Barca cattle type produced the lowest for both total milk (672 kg) and annual milk yield (673kg) (Million and Tadelle, 2003).

Lactation length

A study conducted on Milk Production characteristics of Holstein Friesian Cattle at Holetta dairy farm indicated that the average lactation length is 351 days (Mureja *et al*., 2002). The other research on Horro cows in Ethiopia indicated that lactation length of a cow was on average six months, which is very short ones (Mulugeta *et al*., 1993). Earlier reports (Gebeyehu Goshu and Hegde, 2003) for the Friesian-Borana crossbred cows at Cheffa farm

(Oromia) showed that the average calving interval was 450 days. Cows with 7/8 and 15/16 Friesian inheritance required longer interval (about 474 days) (Gebeyehu, 2005). Research findings on Ethiopian indigenous cattle types indicated that lactation length is less than 100 days of lactation period under average to good management conditions in the Ethiopian context (Zelalem *et al*., 2006).

Lifetime birth

A recent study indicated that the number of calving performance at Cheffa farm (Oromia) was 3.58, which was lower than previous records (Gebeyehu, 2005). A recent study of smallholder farmers in Ethiopia showed that 50%, 75% and 87.5% Holstein Friesians crosses on the average produced 4.7, 3.4 and 2.0 calves, respectively (Ababu Dekeba *et al*., 2004).

Age at first calving

Under controlled breeding system, heifers are usually mated when they are mature enough to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production systems, however, breeding is often uncontrolled and heifers are bred at the first opportunity. This frequently results in longer subsequent calving intervals. The average age at first calving in *Bos indicus* cattle is about 44 months, compared with about 34 months in *Bos taurus* and *Bos indicus* x *Bos taurus* crosses in the tropics (Mukasa-Mugerwa, 1989). Similar study indicated that average AFC was 47.61 and 40.46 months for Fogera and F1 heifers, respectively (Addisu and Hegede, 2003). According to the research conducted at Abernosa Ranch with Borana x Holstein- Friesian (F1 crossbred dairy cows) show delayed age at first conception (53.9 months) (Ababu *et al*., 2006). A

research conducted in Mali indicated that the mean age at first calving was 49.5 ± 3.34 months (Wilson, 1986).

Calving interval

Calving interval can be divided into three periods: gestation, postpartum anoestrus (from calving to first oestrus) and the service period (first postpartum oestrus to conception). The length of the postpartum anoestrous and service periods is sometimes also called the "days open", period and is the part of the calving interval that can be shortened by improveing herd management. The "days open" period should not exceed 80-85 days if a calving interval of 12 months is to be achieved (Peters, 1984). According to Gifawosen *et al*. (2003), economic return from milk production is maximized with a calving interval of 12 months, a dry period of approximately 60 days and days open of 85 days. The duration of this period is influenced by nutrition, season, milk yield, parity, suckling and uterine involution. Estimates of calving interval for zebu cattle ranged from 12.2 to 26.6 months. The Horro and Arsi cattle type of Ethiopia have 12.2 and 12.9-15.1 months of calving interval, respectively (Mukasa-Mugerwa, 1989). The previous study also indicated that calving interval for Ethiopian Zebu ranged from 12 to 24 months, which varies among breeds and animals within a breed (Gifawosen *et al*., 2003). A days open of 248.4, 211.1, 253.0 for Boran, Horro and Barka cattle, respectively, has been reported (Gifawosen *et al*., 2003). Average CI (559days) of Fogera cows at Metekle Ranch was reported (Addisu and Hegede, 2003).

Research conducted at Abernosa Ranch with Boran x Holstein- Friesian F1 crossbred dairy cows showed long calving interval (534.3 days), with average breeding efficiency of 44.6%,

average calving rate of 72% and heifer reproduction efficiency of only 38%(Ababu *et al*., 2006). Similar research conducted in Mali indicated that the observed calving interval was 665 ± 202.2 or just under 22 months (Wilson, 1986).

2.2. Milk processing practices in Ethiopia.

In rural areas, milk may be processed fresh or sour (O'Connor, 1995). The choice depends on available equipment, product demand and on the quantities of milk available for processing.

According to Lemma *et al*. (2005), in East Shoa Zone of Oromia, fresh milk and fermented milk were not consumed on the daily basis; as they were reserved for further processing. In the highlands of Ethiopia, milk produced by smallholders is used for family consumption and for the production of butter and a cottage-type cheese. For butter making, milk is collected over a period of three or four days in a clay pot. When the milk has soured and sufficient milk has been collected, the clay pot is shaken back and forth until butter granules are formed. This method of butter making may take from two to three hours, depending on such factors as temperature, the fat content of the milk, the acidity of the milk and the amount of milk in the clay pot. The time taken to make the butter together with the time involved in taking this butter to the market place is a considerable drain to the smallholders, specifically on that of the wife and family. In order to reduce the time for processing the milk into butter and to improve the efficiency of the process ILCA has developed and modified a wooden internal agitator that can be fitted to the usual clay pot used by the smallholder (O'Connor, 1992). The buttermilk remaining after the butter has been separated from the whole milk is used to produce a cottage-type cheese (ayib) by heating the buttermilk.

Lemma *et al.* (2005) noted that in areas where the climate is hot and humid, the raw milk spoils easily during storage unless it is cooled or when possible treated with preservatives. Nevertheless, these preservatives are not readily available in rural areas, due to this, cooling systems are not feasible because of lack of facilities. In these areas, the farmers have to rely on traditional technology to increase the storage stability of milk and milk products either by converting the milk to its stable products like butter or by treating with traditional preservatives. The same explanation was given by Debrah and Berhanu (1991) that sour milk or yoghurt (Ergo in Amharic) is produced in the traditional system by leaving fresh milk to sour for a few days. Soured milk keeps longer time than raw milk, so this process is useful for storing milk during the day of Wednesdays and Fridays, when Orthodox Christians fast are forbidden to consume animal products.

As Tsehay (2002) pointed out, butter making is an ancient practice that goes back as far as 2000 BC to the time of Egyptian civilization. This butter making may have begun at a similar time in Ethiopia According to O'Mahony (1988), there are different reasons forwarded why smallholder milk processing is based on fermented milk. These are mainly high ambient temperature, small daily quantities of milk produced, consumer preference, the improved keeping quality of fermented milk and the type and capacity of the locally available processing materials and methods used.

Traditional system of butter making differs from place to place and their efficiency in terms of milk fat recovery and time requirement could vary. Here the traditional systems of butter making show low rate of fat recovery (90.53%) and longer time than the improved

technologies (cream separator and butter churn) and the appropriate technology developed by ILCA (internal agitator) (Zelalem and Inger, 2000). Similar study conducted around Borena indicated that butter making is efficient as 85% of the whole milk was recovered as butter reported by Coppock *et al*. (1992).

Traditional butter making requires about 21-25 kg milk to produce 1kg of butter with moisture content of 83% and 3.2-4.5 kg Ayib can be produced from subsequent buttermilk. On the contrary, butter making using Internal Agitator and improved technology had required 20kg and 16-18kg of milk to produce 1 kg of butter respectively (Zelalem and Inger, 2000).

According to Zelalem and Inger (2000), the equipment required for processing sour milk is simple and available locally. The equipments common in the central high lands of Ethiopia were a clay pot and a stick with three to six fingers like projections at one end. According to ILCA (1992), traditional technologies of processing are generally considered to be time consuming and inefficient in terms of milk fat recovery as butter per unit of milk.

There are two types of butter manufactured, namely, cooking and table butter. Women make cooking butter on the farm and sold mainly to itinerant traders or in local town markets, although some may be transported to urban centers and sold to individual consumers, butter merchants or wholesales. Butter is used for cash generation, cooking Ethiopian dishes, and medicinal and cosmetic purposes (e.g. application to the braided hair of women) (Debrah and Berhanu, 1991).

2.3. Milk and milk products utilization and marketing system in Ethiopia

2.3.1. Milk and milk products utilization in Ethiopia

A survey conducted by MOA (1997) in highland peri-urban areas indicated that in most peri-urban areas 74.6% of the milk produced is either used at home or marketed in liquid form while 17.5% fed to calves, 8% churned and marketed in to butter oil state and 0.3% is wasted. Specifically, in Arsi 38.5% and in Gojjam 19% of the milk is converted into butter and marketed. In Addis Ababa, 94.5% of the milk produced in intra-urban and peri-urban areas is marketed in fresh milk form. In Wolaita, 85% is used for butter making where whole milk is not usually consumed.

According to Gtetachew and Geda (2001), 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yogurt while the rest is given to calves and wasted in the process. The consumption of milk and milk products vary geographically between the highlands and the low lands and level of urbanization. In the lowlands, all segments of the population consume dairy products while in the highlands major consumers include primarily children and some vulnerable groups of women. Similarily, milk production and consumption levels, the range of products consumed, and consumers' habits and attitudes in relation to milk products, vary considerably from country to country and even with in a country (Malcon, 1999). For example, wealthy consumers in poor countries regard milk as a basic food product; poor people in poor countries regard milk as a supplement to the traditional diet. The rural poor people use milk and dairy products from their own livestock as a major source of food.

Milk consumption is around 35, 20, 92 and 300-400 liters per person per year in Asia, Africa, Latin America and Western Europe, respectively. Demand for milk and dairy products has increased in the tropical areas where people's incomes have been growing (Malcolm, 1999). It was estimated that between 1970 and 1980 the human population and per capita income in sub-Saharan Africa increased annually by an average of 2.9% and 0.8% per year, respectively (World Bank, 1981). Cow milk production grew at 3.5% per year (Addis *et al*., 1988).

During 1986-88, net annual imports into the developing countries were 32 million tons, which was equivalent to 25% of domestic production (De Boer *et al*., 1994). Projected future demographic changes - population growth, urbanization and income growth imply further rapid increases in the demand for dairy products and the desirability of substantially increased domestic production. However, poor marketing linkages between rural producers and urban consumers due to inadequate infrastructure and inefficient marketing system might have accelerated imports. Getachew and Geda (2001) indicated that demand for milk is inelastic with respect to income and price. So that increasing population growth, rising real income and decreasing consumer prices are expected to expand the demand for milk and milk products.

2.3.2. Milk and milk products marketing in Ethiopia

Unless milk and milk products find a market outlet, they are retained for household consumption and the level of production is kept low (Fekadu, 1994). This low level of production together with the general decline in the local production over the years as a result of the fast growing population, have lead to an increase in import dependence in dairy products. Belavadi & Niyogi (1999) pointed out that rapid urbanization in some developing countries has created domestic demand for high value food items creating market opportunities

for indigenous production, particularly, milk and milk products. Unfortunately, in most part of the country's existing production and rural marketing systems cannot respond readily to the rising demand. In this reason, local government has resorted to an easy option of importing milk and milk products from developed countries either in the forms of food aid or commercial.

The degree of vertical and horizontal integration in a dairy marketing system may vary from country to country, or between regions and milk sheds with in a country (Mohammed *et al*., 1997). For example, in one case most of the milk may be sold and consumed as raw milk while in another case, in addition to raw milk, several processed dairy products such as cheese and butter may be marketed and consumed.

In the lowlands, milk is sold through the traditional methods where women or children directly sell to consumers traveling long distances in the hot climate. Market access in the lowlands is a critical factor in dairy marketing. Those pastoralists, who reside closer to towns, though distances matter, have the advantage of selling liquid milk as compared to those households living in distant areas. A study carried out by FLDP and ILCA (1986) in Borana area indicated that type of marketing, distance to market, season and family wealth in dairy sales are main indicators that determine the sales of milk and dairy products. On the other hand, in Borana area, frequency and amounts of dairy products traded depended on herd size and distance to the market (Holden and Coppock, 1992). Due to this reason, butter is replacing liquid milk with increasing distance and women from households with large herds trading more often. Butter was sold to lorry drivers and bus passengers on the route to Addis Ababa, some 500 km

away. According to Belachew (1997), it was reported that proximity, prices, lack of alternative options and a combination of these factors affect selection of one or the other sales outlets.

Marketing of dairy products, therefore, requires as much emphasis as for the production of milk. Biological interventions to improve the nutritional and health status of dairy animal may not bring about the desired improvements of income to the producers unless viable markets absorb the produce. Lack of market can mean wastage of the milk, and the resources that went in to its production (Labor, land, time). As Tsehay (1998) stated, provision of improved and sustainable milk marketing arrangements in smallholder villages is, therefore, indispensable for advancement of the national dairy industry. An effective milk- marketing net work benefits both producers and consumers, and through its linkages with related sectors, the national economy as a whole (Berhane and Workneh, 2003).

According to Broken and Senait (1992), dairy marketing system in Ethiopia can be classified in to two subsystems: formal and informal marketing system.

2.3.2.1. Formal marketing system

Formal marketing system, which is usually controlled by the government, includes organized collection, processing and distribution of fresh milk and other dairy products at official, government-controlled prices. The Dairy Development Enterprise of Ethiopia is an example of formal marketing systems in Africa. The formal marketing system, in which the milk from the state farms, private farms and subsistence producers within the radius of 150 km around Addis Ababa, is collected at the roadside (milk collection and chilling centers) and taken to a central processing plant (Bennett, 2001).

According to Brokken and Senait (1992) report, there are a number of operational problems contributing to inefficiency dairy marketing in the formal marketing channels such as irregular and delayed payments, inefficient plant operations, insufficient local supply and low capacity utilization.

2.3.2.2. Informal marketing system

In the informal marketing system, the smallholder sells their surplus supplies to neighbors or in the local market, either as liquid milk or in the form of butter or a cottage-type cheese (ayib) (Bennett, 2001). Similar study by Mohamed (2000) indicated that the informal market involves direct delivery of fresh milk by producers to consumer in the immediate neighborhood and sale to itinerant traders or individuals in nearby towns. In the informal market, milk may pass from producers to consumers directly or it may pass through two or more market agents. The informal system is characterized by no licensing requirement to operate, low cost of operations, high producer price compared to formal market and no regulation of operations.

According to Brokken and Senait (1992) the main problems for efficient dairy marketing in the informal sector of SSA are the small quantities supplied per farmer, seasonal fluctuations in supplies, the low volume of milk per square kilometer (low density), poor and seasonally impossible roads, in availability of transport and low level of education about collection and preservation of quality milk. The advantages of the informal system are low cost, with short marketing channels and potentially good prices for producer and consumer, possibility for small farmers to participate in milk production and marketing and limited competition with imported products. Where as the disadvantages are no payment for quality and fat content,

possibilities for adulteration, problems with seasonal fluctuations in production and no public health control.

According to Bennett (2001), both formal and the informal milk marketing system exist in Ethiopia. Both commercial (urban and peri-urban) and smallholder (rural) farmers use the formal and informal channels to sale milk and milk products.

2.3.2.3. Milk marketing group

Tsehay (1998) explained that a third marketing channel (milk marketing group) is introduced and being popularized in the Ethiopian highlands. Farmers, milk-marketing group is a group of smallholder farmers who individually produce at least one liter of saleable milk and are willing to form a group with the objective of collectively processing and marketing milk.

2.4. Beef production system

2.4.1. Overview of fattening in the tropics

According to Pagot (1992), fattening is defined as the preparation of animals for butchering, whichever method may be used. Increased in yield can be obtained by improvement of the genetic qualities of the animals and by improvement of environmental conditions which include the fight against pathological factors and, above all, by improvement of feeding. Cattle fattening, is dependent up on the development of forage resources.

Fattening techniques relies on a minimum time of three months up to a maximum of about 18 months to 2 years. The length of the period depends up on the characteristics of the animals

used and the food resources available. So that based on feeding regimes and the nature of the main products used, fattening operation could be classified in to three systems (Pagot, 1992).

Grass fattening

This system is still the most widely practiced. It consists of reserving the best pastures for the animals destined for slaughter and giving them the most attentive care during the space of time necessary to reach the live-weight required. Feeding is basically forage with, sometimes, a small supplement of mineral or concentrate. The animals are maintained permanently at pasture. Grass fattening is a technique which is economical in material and human resources, but which generally implies a certain loss of energy by the animals when they move from one place to another to change pasture. Further more, daily live-weight gains are often low (Pagot, 1992).

Intensive fattening

In this system, the animals are confined in feedlots or pens and receive in the trough a completely balanced ration of forage, concentrate feed or diverse agro-industrial by- products. These techniques should experience considerable development in all the regions where agricultural activities, which produce residues and by-products (rice, cotton, and sugar) (Pagot, 1992).

Industrial fattening

The development of certain crops, such as sugarcane, cotton, and oil palm, leads to the establishment of industrial processing activities (sugar refineries, cattle cake factories, oil mills) which generate by- products, which can be used for livestock feeding (Pagot, 1992).

2.4.2. Cattle fattening practices in Ethiopia

i. Traditional systems

Cattle are kept mainly for draft power, milk, and manure production and are usually only sold when they are too old for these purposes, or drought or cash shortages force people to sell. Oxen are usually sold after the plowing season when they are in poor condition. Meat yield are low, the beef is poor quality and farmer returns are often inadequate to buy a replacement ox. There is obvious scope to improve this traditional and inefficient system through strategic feeding of good quality forage to fatten animals before they are sold, or to buy and fatten animals sold by others.

In the lowland, where pastoralists do not use cattle for draft and sometimes fattened on natural pasture in good seasons, however much body weight is lost during long distance trekking to Addis Ababa and the animals may reach market in little better condition than culled highland stock. In average or poor seasons, lowland cattle are rarely fattened and often have to be sold in poor condition at low prices.

These traditional systems are very inefficient because they do not use the proven opportunity to add weight and condition to cull animals before slaughter. Several improved systems are in use, but none of them are widespread yet.

ii. Product-Based Fattening

In 1976 E.C., Ministry of Agriculture (MOA) began to help peasant farmers in Debre Zeit area to fatten purchased cull oxen using molasses and milling by- products. This has produced

profitable results for the individuals involved, and the number of animals fattened has increased every year to about 2,000 per annum (MOA, 1990). By- product-based fattening in Debre Zeit area is feasible because; it is close to the main source of agro-industrial by-products (molasses, cereal milling by-products and oilseed meal); grazing land is almost completely unavailable and crop residues are the only significant roughage source; and it is close to the largest and highest priced market for finished beef animal and lies on the major trekking route to that market. By-product based fattening is not recommended for other parts of Ethiopia, except places where oilseed cake is abundant and cheap (MOA, 1990).

iii. The Hararghe fattening system

Intensive feeding of the available feed supply to young oxen they are using for draught power could best describe the Hararghe fattening practice. The feed types used for the fattening are entirely obtained from crop production especially from maize and sorghum. Pagot (1992) substantiated that in Ethiopia the farmers fatten young bullocks at the edge of the fields with lower leaves taken from the stems of sorghum.

Among the most common feed types used for fattening, thinning, leaf strip and part of maize and sorghum plants are major feeds offered to fattening animal during the main and early dry seasons. This tradition is seasonal undertaking to utilize seasonally available feed. During abundant feed supply, the animals are offered in ad-libitum. Farmers extend animal's daytime feeding up to nighttime and supplement the animal with common salt or locally available mineral licks twice a week. The nighttime feed offering is used to supplement the amount of

daytime dry matter consumption and to compensate under supply of feed during daytime as in the case when the farmer is away from his house.

During short rainy season, they allow their oxen to graze at the edge of farm plots or roadsides for 1.5 to 2 hours every morning before sunrise. In the cases where the farmer has more than one ox, he transfers the second one to his relative or person in the same village to feed for him after using for traction (Fekadu and Alemu, 1999).

2.5. Meat consumption in Ethiopia

According to Abbey (2004), many Ethiopians, like other developing countries, do not consume adequate amount of meat. The few that do, however, maintain a meat diet of beef, sheep, goat, and poultry. In 1987, 51% beef, 19% sheep, 14% goat and 15% poultry contributed to a meat diet composition. Most Ethiopians do not consume pork, in addition to many types of fish, due to religious factor.

Consumption of sufficient meat is a rare extremity in most developing countries. Developed countries consumed a consistent level of 77 kg of meat per capita annually, while developing countries struggled to maintain a diet with only 25 kg of meat per capita annually. Ethiopians remained slightly below the meat intake of all low-income countries and consuming 9 kg per capita annually (Abbey, 2004).

2.6. Cattle marketing system in Ethiopia

According to UNDP-EUE (2002), Livestock marketing in Ethiopia follows a three-tier system: primary, secondary and terminal markets through which animals go into the hands of small traders and then to large traders, final buyers, which include butchers, meat-processing factories, fattening farms or live animal exporters, purchase livestock at any stage.

Livestock export is an important source of foreign exchange for the country. The Ethiopian Livestock Marketing Enterprise and state-owned parastatal exports live animals mainly to Middle East countries. On average, it was exported 10,292 steers and yearlings, 138,621 sheep and goats annually between 1980/81 and 1990 /91 (Tilahun Fekade, 1994). Formal private sector involvement in the export market has been limited due to competition from the illicit trade (i.e. smuggling to neighboring countries) and government restrictions.

There are about 120 livestock market centers recognized by the Ministry of Agriculture. Most of these places have no well-organized marketing infrastructure to offer basic watering, feeding, resting and quarantine facilities. The situation is worse in pastoral areas, where only some have perimeter fencing to facilitate tax collection (Sintayehu, 1993).

According to Belachew and Jemberu (2003), Ethiopia's low land cattle breed, sheep, goats and camels are highly demanded in neighboring countries as well as the strategic livestock markets of the Middle East. Over all, relatively huge number of livestock resources, proximity to the export markets, conducive investment policies, the liberation of the economy and the supports and attentions given by the government to export trade gives the country comparative advantages in livestock trade. However, inadequate market infrastructure, virtual absence of market information system, absence of market oriented livestock production, inadequate

number of exporting firms with low level of capacities, inadequate knowledge of international trade law, level of quarantine facilities and prevalence of various diseases, repeated bans, excessive cross-border illegal trade and stiff competitions, etc are the major challenges that hinder the smooth livestock trade in Ethiopia.

The pastoralists are situated in peripheral areas bordering neighboring countries. Thus, they are in the vicinity of neighboring countries markets for livestock. Livestock are traditionally flown out of the country from Afar and Somali regions, Borena zone of Oromia and Omo lowlands bordering Kenya. The neighboring countries bordering these areas either consume locally or re-export to the Middle East countries (Belachew and Jemberu, 2003).

According to Ayele *et al*. (2003), although live animals make a considerable contribution to the economy in terms of export earnings, a great number of the country's live animals have been traditionally smuggled to neighboring countries. The ban on import by Middle Eastern countries has led to increased illegal sale of livestock through Somalia and Kenya and to a lesser extent through Sudan and Djibouti. Some of the reasons identified as contributing to illegal exports are excessive regulations involving several ministries and agencies and related fees. Overall, transaction costs in dealing with these agencies for export clearance are also apparently high in terms of both time and money.

3. MATERIALS AND METHODS

3.1. Description of the study area

The study was conducted in Metema district, which is found in North Gondar zone, Amhara Regional State (Figure 1). Metema is situated about 925 km north west of Addis Ababa and about 180 km west of Gondar town. Metema is found north of Quarra and Alefa, west of Chilga, south of Tach Armachoho districts of north Gondar zone and east of Sudan Nation. Metema is a border district and it accounts to more than 60 km of the international boundary that Ethiopia shares with Sudan.

Metema is located between 12^0 40' 00" N latitude and 36^0 8' 00" E longitudes ([1]MDOA, 2006). The area is semi-arid and the people in the area grow a variety of crops for home consumption and sale, mainly sorghum, sesame and cotton, as well as maize, teff and millet to some extent.

Climate and soil condition

The altitude of Metema ranges from as low as 550 to 1608 m.a.s.l. Where as, minimum annual temperature ranges between 22 ^oC and 28 ^oC, daily maximum temperature becomes very high during the months of March to May, during when the temperature can reach as high as 43 ^oC (MDOA, 2006). The mean annual temperature is about 31 ^oC.

Mean annual rainfall of Metema area ranges from about 850 to around 1100 mm, and it receives a unimodal rainfall (MDOA, 2006). The rainy months extend from June to the end of

[1] MDOA is abbreviated as Metema district office of Agriculture.

September. However, most of the rainfall is received during the months of July and August, during when the rainfall is erratic. Evapotranspiration rate is high in Metema, as a result, the area is dry land with eratic and shortage of rainfall, which implied major constraints of agriculture in the district. On the other hand, when the rainfall is heavy, water logging becomes a problem for crop production. Rainfall is usually intense and short even though the rainy months seem to be extended.

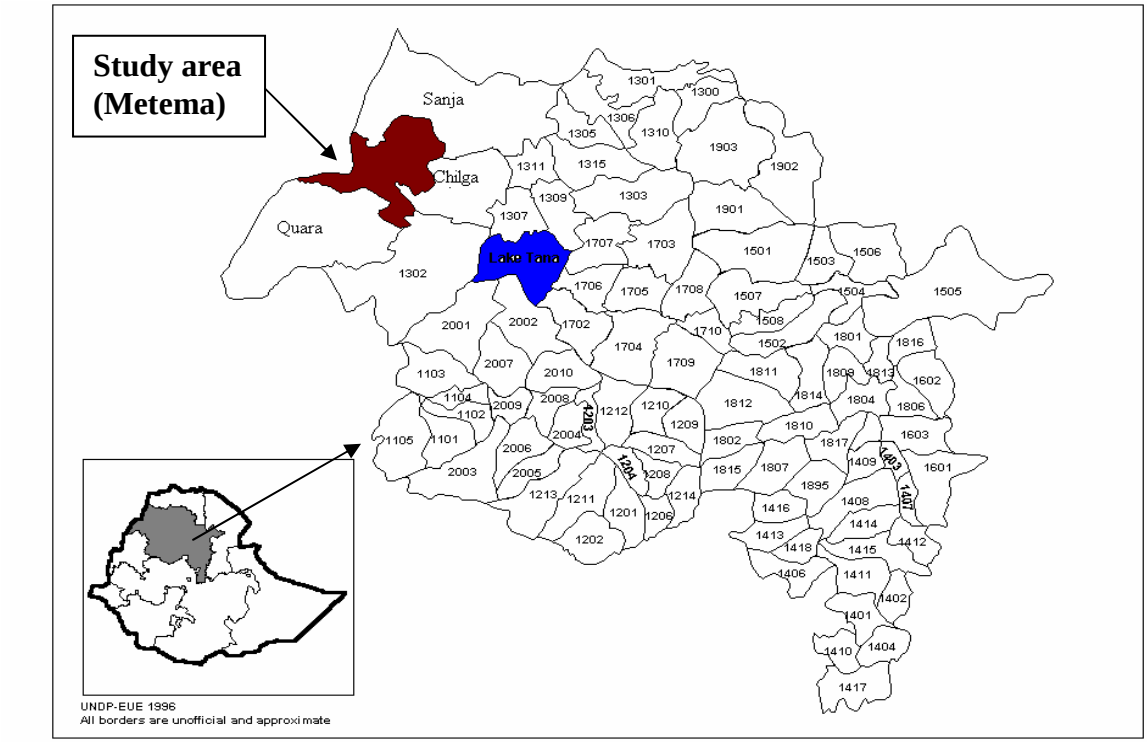


Figure 1**:** Administrative districts of Amhara region indicating Metema district, the site of the present study. Inset, Map of Ethiopia showing Amhara Regional State.

The soil in the area is predominantly black with vertic properties. Due to this reason, the soil in most areas is observed with excessive cracks, which could be as deep as 0.75 m in some places during the dry season. There are about 9 types of soil in the area, amongst of which Haplic Luvisols prevail for about a quarter of the district and Vertisols or soils with vertic properties

exist for about 22% of the districts land area. On the other hand, Humic Nitosols account for about 6%. Seasonal water logging, especially during the months of heavy rainfall, is so high and ILRI (2005) recommends the need to use broad bed makers (BBM) to drain the excess over flow and use the land for crop cultivation or grazing purpose.

Human population

According to MDOA (2006), there are 15,675 rural agricultural households (excluding the newly resettled households) and about 4,991 urban households. According to this estimate, the total population of the district was 91,216 people. Out of the total 20,666 households, 3918 and 1497 are rural and urban women headed households, respectively. The original native of the area are Gumuz. Until recently, they practice hunting wild animals as a means of living. Because of the initiation of settlement programmes, the area is populated and the natives became minority in number. They are concentrated in few localities and live close to each other. The natives are found in only three Kebles (Kumer-Aftit, Tumet and Shinfa) of the district (MDOA, 2007). The total number of the indigenous people is estimated at 500 households. Hence, much of the area is recently settled by new comers from the highlands (ILRI, 2005).

Livestock resource

Livestock production is an integral part of the production system. Production of cattle (milk, meat), goat (meat) and poultry is a common practice. Cattle were exported formally & informally (smuggled) to Sudan, while goats are mainly sold in local markets. There is a smallholder milk and butter production system mainly for the local market. Transhumance

cattle production system is a common phenomenon by the highlanders. They are coming to the lowlands during the main rainy seasons from May to October mainly in search of feeds. There is a huge feed resource in the district and haymaking has recently been introduced in some selected Kebles. According to MDOA (2006), livestock population in the district is composed of 136,910 cattle, 32,024 goats, 1,686 sheep, 7,164 male donkey, 7,127 poultry and 23,789 beehives.

The cattle population in the district is quite high as compared to other livestock species. Cattle in the area are used for traction, meat and milk production. Major cattle type is Fogera zebu crossbred. On the other hand, Ruthana cattle originally from Sudan and Felata cattle from Niger and Nigeria also constitute smaller proportion of the cattle population. According to farmer's preference, Ruthana cattle are preferred due to their larger frame size, better milk yield and traction power (ILRI, 2005).

Land use pattern

Total area of the district is about 440,085 ha, of which 103,908 ha is cultivated land, 312,300 ha allocated to forest and grassland 23,877 ha as uncultivable land. More over, almost 60 % of the district is plain area, while the rest of the areas are hill (15%), sloppy (20%) and valley (5%) (MDOA, 2006).

Farmers in the district cultivate sesame (extensively), cotton and sorghum. They produce sorghum as the staple crop, which is the major food crop in the area. In few areas of the district, vegetables and fruits are grown on the irrigated land by using major rivers (Guange

and Gendawuha) with the provision of technical assistance from IPMS (Improving Productivity and Market Success of Ethiopian farmers) Ethiopia.

Farming systems in Metema districts

According to ILRI (2005), Metema district was categorized in to cotton, rice/ livestock based and sesame, cotton, sorghum and livestock based farming system. The livestock production system is similar in both farming systems.

The cotton, rice/ livestock farming system prevail in four of the 18 kebles of Metema district, namely Meka, Awlala, Gendawuha and Kemechela. They are found northeast of the district. These kebles predominantly grow cotton followed by sorghum and sesame in few areas. The cotton based areas is relatively higher in altitude and thus the temperature is relatively cooler and receives better rainfall. The soil is largely dominated by black vertisol and water logging is a problem. As a result of its cooler climate and relatively better moisture, most of the early settlers preferred the cotton based areas of Metema district than the sesame dominating areas. Cotton is grown extensively in large farms, while sorghum and sesame are planted in smaller plots of land. According to MDOA (2006), livestock population more abundant in two of the four kebles found in this farming system, namely, Awlala and Kemechela.

On the other hand, sesame, cotton, sorghum and livestock based farming system prevail in 14 of the 18 kebles of Metema district, namely, Awassa, Achera, Shashge, Metema-Yohanes, Gubay-Jejebit, Lencha, Shinfa, Kokit, Zebach-Bahir, Tumet-Menduka, Das-Gundo, Agam-Wuha, Kumer- Aftit and Mender (6, 7, and 8), amongst of all, the first eight kebles have high

livestock population. Sesame, cotton and sorghum are the major crops in this farming system (listed in the order of importance). Environmental conditions are equally suitable for these crops. Majority of the land mass have lower altitude than the areas in cotton based system and hence it receives lower rainfall than the cotton dominated areas. This area also has extensive abundant natural forest trees of gum and incense. There is still vast area of open or uninhabited land. As a result, most of the recent settlements took place in these places unlike the cotton-based areas where most of the early settlements took over.

3.2. Sample selection procedure

A multistage sampling procedure was employed to select representative kebles and households. Kebles were purposively selected from each of the two farming systems based on the population of livestock in each Keble. Accordingly, two of the four kebles (Awulala and Kemechela) that had relatively higher livestock population in the cotton based farming system were considered for the study. Like wise, the six kebles mentioned earlier as having higher livestock population in sesame based farming system were considered for the study. Thus, nearly 50% of the kebles from each farming system were sampled in the present study.

In addition to the selected eight kebles from rural areas, Gendawuha town, which is the capital of the district, was also considered as the ninth sampled site for the study. Gendawuha town has two kebles and 30 households were selected from both kebles. The town is almost found in the cotton based farming system areas but it is somewhat different from other rural kebles. It is an urban center and that is why it was purposively selected as one of the study site. Most of the inhabitants of Gendawuha town possess farmland in the adjoining rural areas, while living

as a resident in the town. Therefore, they produce both livestock and crops on their holdings in rural areas.

Based on the above stratification by location, lists of farmers in each of the selected kebles were obtained from keble administration heads, agricultural extension officers and development agents (DA) and from official land registry list. A systematic random sampling method was employed to select 30 households from each of the selected rural kebles. Where as, 15 households were selected from each of the two urban kebles found in Gendawuha town. In due regard, total sample size of 270 households were selected from the study district, of which 60 households were selected from cotton based farming system areas, 180 were from sesame based farming system areas and the rest 30 were selected from Gendawuha town.

3.3. Data collections techniques

Three sources of information were considered to collect the required data. Secondary data was collected to acquire a general understanding of the area. PRA techniques such as individual and group discussion with key-informants was held to collect wide range of qualitative data. Focused formal survey was conducted using semistructured and pretested questionnaire to quantify some of the important parameters for the study.

The specific procedure used for data collection depended on the type of data sought and the sources of information. Basically the study composed two main components as characterization of cattle milk and meat production system and processing techniques as well as description of marketing system of these products. Accordingly, the procedures of data collection pertinent to the two component studies are discussed separately.

3.3.1. Collection of production and processing related data

Primarily, over view of the area was perceived through discussion held with agricultural extension officers, experts and development agents. Group discussion with key informants were also employed to know the over view of milk and meat production system in the area. A questionnaire-based survey was used to collect data needed for assessment of production and processing of milk and meat in the area. Before starting data collection, the questionnaire was translated in to Amharic and pre-tested using purposively selected key informants, such as elderly persons and farmers with long time of experience in livestock husbandry. Accordingly, many of the questions in the questionnaire were also restructured or rephrased for the purpose of clarity.

Questionnaire based data collected for assessment of production and processing systems included the following variables, namely, socio-demographic characteristics (age, sex, marital status, family size, educational background, primary occupation, income sources, landholdings), cattle herd structure, cattle breeds, experience and purpose of cattle rearing, productive and reproductive performance of cows, breeding system and types of bulls used, feeds and feeding system, water sources, manure management, cattle health and disease problems, the type and amounts of milk and meat products produced, handling and processing of milk and meat, utilization of cattle milk and meat, the type and market share of milk and meat.

The survey was conducted between September and October 2006. While interviewing, the researcher were assisted by development agents (diploma holders) and apparent ship students,

who had been trained in interviewing techniques before data collection. In addition, data collection was performed under close supervision of the researcher. Accordingly, enumerators were visited and monitored regularly while conducting the survey as well as each questionnaire was promptly checked up on submission to verify biased and ambiguous information and when necessary, concerned enumerators were promptly contacted for explanation while they have fresh memory about the issues.

In addition to the formal survey, group discussions were held with key informants in each farming system areas with the help of topical guidelines (checklists) for some qualitative milk and meat production, processing and utilization parameters. This provided additional information to characterize milk and meat production systems and processing methods in the study area.

In addition to data taken using informal and formal survey, quantitative data were collected from fifteen voluntarily selected households from the two farming systems and they were continually monitored to collect data on milk and other dairy products produced and processed per households. The researchers himself as well as family members of the selected households were involved in data collection process. Accordingly, one of the family member, who had at least attended grade 6 or above level of education was selected and adequately trained about taking measurements on each variable and filling the format prepared for data collection.The data collected includes milk yield/day/cow in the selected household, amounts of fermented milk churned at a time and butter yield during each churning. The purpose of collecting these data was to corroborate the information on these variables collected through questionnaire.

Regarding milk yield, 45 indigenous milking cows were used to collect daily milk yield from the selected 15 households. The stage of lactation was not taken in to account because of limitation in accessing cows with different lactation stage with the limited time. Milk yield was recorded both in the morning and in evening milking time every other day for a period of one month. Milk produced during each milking was measured using a one liter holding plastic container locally known as "*Joge"*(holding 1 liter) *and merti tasa* (holding 800 ml), which are available in every household . The container in each household was graduated at a quarter of a liter interval so that the recorder read the amount of milk to the nearest 0.25 liter. Similarly, the quantity of fermented milk (Ergo) and butter were measured before churning and at the end of churning, respectively, using the provided weighing balance.

3.3.2. Rapid Market Appraisal

In order to characterize the marketing system of marketable milk, milk products, meat and live cattle for meat purpose, Rapid Market Appraisal (RMA) techniques was employed (Holtzeman, 1986; Menegay *et al*., 1988; Miles, 2000). Before administering RMA on the different marketing agents, the number of permanent butter traders, ergo sellers, cattle traders, butchers in the study area were identified. The qualitative data obtained from these market agents was used to summarize marketing chains, marketing channels, marketing problems and possible solutions.

In the study area, producers, traders, butcher houses, cattle exporters and consumers were identified as a marketing agents. Available butter and cattle traders were interviewed with the help of separate topical guidelines (checklists) at the four main market places in the district, namely, Gendawhuha, Kokit, Meqa and Shinfa. In addition, available small amount of ergo

sellers, butcher houses and cattle exporters were interviewed with the help of separate topical guidelines (checklists) at their respective sites. Where as, the producers (N=270) as a whole were interviewed with the help of semi structure questionnaire, which contained questions about production and marketing system.

The checklists were used to collect data on aspects like: the type of business, place of purchase and sale, volume of purchase and sale, time of purchase and sale, types of buyers, prior arrangement, mode of payment, availability and sources of market information, factors affect price as well as constraints in buying and selling the different products.

Moreover, to study marketable oxen's live weight and body condition in relation to their market price, heart girth measurement of male oxen were taken at the four major market places of the district. This information was used to estimate the liveweight and condition of marketable oxen and price offered at each market place.

3.4. Data analysis

Statistical analysis of the primary data was made using the statistical package for Social Science, (SPSS, 2003) version 12. Survey results were reported using descriptive statistics. General linear model (GLM) was employed to evaluate the relations between dependent and independent variables. ANOVA test used to investigate the effect of farming system difference on different variables.

Data related with pricing, collected for the characterization of dairy marketing system were analyzed using descriptive statistics and data collected using RMA technique were reported with flow charts and summarized discussions.

Chi-square tests and General Linear Model (GLM) were employed to test different variables in the three locations. Significances were declared at 5 % level and up on identifying significant F, tukey multiple comparison test was performed to separate significantly differed means. The specific ANOVA model used for the test was as follows:

$Y_{ij} = \mu + A_i + \varepsilon_{ij}$

Where, Y_{ij}= Induvidual observation on the respective dependant variables (Variables in the i^{th} location).

μ = The overall mean value.

a_i = Independent variables(location where i = 3, CBFS, SBFS and Gendawuha town).

ε_{ij} = Random error term.

4. RESULT AND DISCUSSION

4.1. Cattle production system in Metema

Two types of cattle production systems were identified in Metema district namely, transhumance and crop-livestock mixed production systems, each type is described below.

4.1.1. Transhumance production system

Transhumance production system in Metema is characterized by seasonal displacement of herds from the highland part of North Gondar Zone to the lowland area (Metema district). The herders move from the highland to Metema in search of better or suited grassland. In the highland, the herders are not usually able to find enough forage around the village for their livestock through out the year. Thus, temporary migration is an option for them.

The transhumant come to Metema exclusively during the rainy season due to shortage of sufficient quantity and quality of forage during the rainy season in the highland because croplands in the highland are extensively cultivated and covered with different crops and the small available grazing lands become too wet and muddy. As reported by the farmers, at times grazing lands are covered with flood and the threat of bloat is common because of consumption of young trifolium, rejuvinated following the rains.

The transhumance moves to the lowlands during the on set of rains (usually during the first week of May) and returned back to their village during the end of rainy season (usually at end of October). However, throughout the dry season animals were kept around their village (in the highlands). This is because, there is comparably enough alternative feed resources in the form of crop aftermath, crop residues and hay. During the dry season, the environmental condition

in the lowland is not conducive for the highland animals. Thus, the transhumance preferred to stay around their village instead of going to the lowland (Metema) during the dry season.

The transhumance usually came from the highland districts such as Chilga, Dembia, Gondar Zuria, and to some extent Alefa district. This type of production system is entirely exercised by the highlanders of those districts living outside the study area (Metema). Because of this reason, thorough characterization of the transhumance production system could not be made during the limited field survey period and thus, the present study was mainly focused on cattle production in the crop-livestock mixed production system, which is practiced by the residents of Metema district.

4.1.2. Crop – livestock mixed production system

Unlike the transhumance production system, the crop-livestock mixed production system is the predominant system and exists in all over the district through out the year. Therefore, throughout this document the two production systems are referred as cotton-livestock and sesame-livestock production systems for ease of presentation.

With the exception of natives, the farmers in Metema district, who practice mixed crop-livestock production system were settlers, originally came from different highland areas of the northern part of the country (Gondar, Wollo, North shewa and Gojjam). As a highlander, these settlers had been exercising crop-livestock mixed production system before they resettled in Metema or at least they are descendents of highlanders who were practicing mixed farming. As a result, they kept on practicing the same production system even in the lowland (Metema). Therefore, the previous experience of the settlers greatly influenced them to continue

exercising mixed crop-livestock production system, which is a feature not typical among original lowlanders found in such arid low land marginal areas in other parts of the country. Since the present study was mainly focused on resident of Metema district, the discussion given here in after refers to the mixed farmers.

4.2. Socio-economic characteristics of residents in Metema

4.2.1. Household characteristics

Family size, sex and age structure of the farm families in the two farming system and Gendawuha town areas are presented in table 3. Mean family sizes in cotton based (5.5 person/HH), sesame based farming system (5.6 persons/HH) and Gendawuha towns (6.6 persons/HH) were not significantly ($P>0.05$) different (Appendix table 1). The overall mean family size in Metema district was 5.7±0.134 persons/HH. Among these household members, 54.64% and 45.36% were males and females, respectively. The family size values obtained in Metema district is higher than the national average (5.2), reported by CACC (2002). On the other hand, larger family sizes (7.39±0.17) were reported in Shashemene- Dilla areas (Sintayehu, 2007).

Table 2: Family size, age and sex structure of farm families under cotton based, sesame based farming system and Gendawuha town in Metema district

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
HH Head:								
Sex :	N=60		N=180		N=30		N=270	
Male headed	58	96.7	154	85.6	28	93.3	240	88.9
Female headed	2	3.3	26	14.4	2	6.7	30	11.1
Mean age(SE):		42.5(1.45)[a]		39.4(0.74)[a]		49.5(1.98)[b]		41.2(0.65)
HH members:								
Age category:								
< 6 years	54	16.3	185	18.2	21	10.6	260	16.9
6 - 15 years	112	33.8	311	30.6	52	26.3	475	30.8
16 - 60 years	162	48.9	505	49.8	120	60.6	787	51.0
> 60 years	3	0.9	14	1.4	5	2.5	20	1.3
Sex category:	N=60		N=180		N=30		N=270	
Male	197	59.3	554	54.5	92	47.2	843	54.6
Female	135	40.7	462	45.5	103	52.8	700	45.4
	N=60		N=180		N=30		N=270	
AFS(SE)		5.5(0.27)[a]		5.6(0.16)[a]		6.6(0.47)[a]		5.7(0.13)

Means with the same superscript within the same row are not significantly different at 5% level of significance.
HH = Household, SE = Standard error, * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count, AFS = Average family size

Among the investigated households, 89% were male-headed, while the remaining (11%) respondents were female-headed households (Table 3). The overall average age of the household head was 41.2 years and it ranged from 19-85 years. Concerning the overall age categories, 51% of the household members were in the age group between 16- 60 years old, while 30.8% of household members were between 6-15 years old. Where as, 18.2% of household members were in the age categories less than 6 years and above 60 years old (Table 3). This indicates that family members in the productive age group were higher than that of the non-productive age groups (dependents) and this in return implies that in Metema households have good sources of labor to utilize for different farm activities.

Educational background of the households is summarized in table 4. The overall educational status of the households indicated that about 45% were literate, amongst of which the majority (67.2%) were those that had adult education or read and write, and followed by primary education (28.7%). Comparing the education of household heads in different areas, proportionately there were more illiterate in cotton based (63.3%) than in sesame based (52.8%) or Gendawuha town (50%). Household heads that received adult education were comparable in cotton based (31.7%) and sesame based (31.1%) but the proportion was less in Gendawuha town (23.3%) than in the two rural areas. On the other hand, household heads that received primary education or above was relatively higher in Gendawuha town (26.6%) than in sesame based (16.1%) or in cotton based system (5%). In this regard, household heads in sesame based had better educational background than in cotton based (Table 4).

Table 3: Relative frequency of households with different educational background in cotton based, sesame based farming systems and Gendawuha town in Metema district

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Educational background	HHC	%	HHC	%	HHC	%	HHC	%
HH head:	N= 60		N= 180		N= 30		N= 270	
Illiterate	38	63.3	95	52.8	15	50.0	148	54.8
Read and write	19	31.7	56	31.1	7	23.3	82	30.4
Primary school	2	3.3	26	14.4	7	23.3	35	13.0
Secondary school	1	1.7	3	1.7	0	0.0	4	1.5
Above seco. school	0	0.0	0	0.0	1	3.3	1	0.4
All members of HHs:	N = 60		N = 180		N = 30		N= 270	
Literate	118	43.2	496	59.0	123	66.1	741	56.83
Illiterate	155	56.8	345	41.0	63	33.9	563	43.17

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count, HHs = Households

Religion, ethnic group and primary occupation of the interviewed farmers are presented in appendix table 2. The dominant religions in cotton based, sesame based farming system, and Gendawuha town are Orthodox Christians (93%) and Muslims (7%) followers. With regards to ethnicity, the overall interviewed farmers were Amhara (92.6%) and Tigray (4.5%). The rest (3%) were Gumez, Agew and Oromo ethnic groups. The primary occupation of household heads in sesame based farming system and Gendawuha was more or less comparable, while the primary occupation of household heads in cotton based was entirely agriculture, which is different from sesame based farming system and Gendawuha. Overall, the household heads'

primary occupation was farming (95.9%) and the rest were traders (2.6%), government workers (0.7%), drivers (0.4%) and carpenters (0.4%) (Appendix table 2).

4.2.2. Land ownership

Relative frequency of landholding categories and average landholding size in cotton based, sesame based farming system and Gendawuha town are presented in table 5. The mean land holdings of households in cotton based (4.03±0.316 ha), sesame based (9.11±1.276 ha), and Gendawuha (13.60±5.122 ha) were significantly different ($F = 3.674$, $P = 0.027$) (Appendix table 3). Mean landholding of households in cotton based farming system was significantly smaller than average land holdings in sesame based farming system and Gendawuha town resident farmers ($P<0.05$) (Appendix table 3).

As shown in table 5, the average land holding in sesame based farming system (9.11 ha) and Gendawuha town (13.60 ha) appears to be over inflated, because of few respondents that possessed large size farmland for commercialization. For instances, 8.7% of inhabitants in sesame based farming system and 10% in Gendawuha had > 15 ha and all of them were involved in enterprise farming. Thus, excluding these households, average landholding per household calculated for the rest of the households was 5.6 ha for sesame and 6.0 ha for Gendawuha. These values may better represent the average holdings of the majority of residents in these two places. Where as, in the cotton based all the sampled households owned < 15 ha and they were not involved in enterprise farming. Thus, the calculated mean holding (4.03 ha) can be considered as a representative holding for the majority of the residents. In addition, ANOVA test excluding enterprise farm holders declared significant differences in

holdings among the three places (F = 5.924, P = 0.003) (Appendix table 4). Mean separation test excluding enterprise farm holders indicated that residents in cotton based possessed significantly less land than those in sesame based rural kebles and Gendawuha town but differences were not significant between the latter two (Table 5). Similarly, excluding few households that possessed > 15 ha and involved in large enterprise farming, the average holding for Metema area was calculated as 5.28±0.215 ha (Table 5). This figure is better representative of the average holding of the majority in Metema area. The landholding in Metema area is quite large compared to many places in the country. For example, the overall average land size in Shashemene- Dilla areas was 1.14 ha per household (Sintayehu, 2007), which is much smaller than the average holding of Metema residents found in the present study. The reason for large landholding/household in Metema may be the fact that Metema is relatively a recently inhabited area. In addition, it is arid marginal land and the population is fairly sparse compared to cooler highlands, which are inhabited several generations back.

Comparing holdings with in Metema, relatively more inhabitants owned larger than 15 ha of land per household in sesame based farming system (8.6%) and Gendawuha town (10 %) than in cotton based farming system (Table 5). On the other hand, more inhabitants owned < 4 ha of land in cotton based farming (63.3%) than in sesame based farming system (39.6%) and Gendawuha town (33.3%). Thus, farmers in sesame based farming system and Gendawuha town afford to posses larger farmland than those in cotton production system (Table 5). This is because, areas in cotton based farming system are relatively cooler and were inhabited relatively earlier than the drier and hotter sesame based areas, which were inhabited by highland resettlers relatively more recently.

Table 4: Relative frequency of landholding categories and average landholding size in the two farming systems and Gendawuha town.

Landholding	*CBFS*[*]		*SBFS*[**]		*Gendawuha*		*Overall*	
category(ha)	HHC	%	HHC	%	HHC	%	HHC	%
0 to 2	17	28.3	28	16.3	6	20.0	51	19.5
2 to 4	21	35.0	40	23.3	4	13.3	65	24.8
4 to 6	11	18.3	31	18.0	7	23.3	49	18.7
6 to 8	7	11.7	21	12.2	2	6.7	30	11.5
8 to 15	4	6.7	37	21.5	8	26.7	49	18.7
Above 15	0	0.0	15	8.7	3	10.0	18	6.9
Total HH(N)	60		172		30		262	
[***]Mean(SE)	4.03(0.32)[b]		9.11(1.28)[a]		13.60(5.12)[a]		8.46(1.03)	
Total HH(N)	60		157		27		244	
[****]Mean(SE)	4.03(0.32)[b]		5.63(0.28)[a]		6.04(0.73)[a]		5.28(0.22)	

Mean landholding with same superscript with in the same rows do not significantly differ at 5% level of significance. [*]CBFS= Cotton based farming system, [**] SBFS= Sesame based farming system, [***]Mean landholdings including large size of enterprise farms (> 15 ha). [****]Mean landholdings excluding large size enterprise farms (> 15 ha), SE = Standard error, HHC = Household count.

90.89% of sampled farmers in the district allocated their farmland to annual crops, 0.01% for perennial crops, 1.13% for grazing land and the rest 7.97% left for fallowing. In the present study, it was noted that farmers commonly abstain ploughing their farmland for about 1-3 years for the purpose of rehabilitating their farmland. From the results reported above the proportion of land allocated to grazing land seems small as compared to arable land. This is

because the district as a whole has abundant forage resources during wet season from large area of communal grazing and forestlands.

4.2.3. Sources of income

Major sources of income and prioritization of commodities used as a source of cash in Metema district are presented in table 6. Live animals and crop sale were the major source of cash income for inhabitants of Metema district and these two sources accounted more or less equal share in all the three areas, i.e., in cotton based, sesame based rural communities as well as Gendawuha town. Following these, sell of butter contributed considerable amount to the income of households in cotton based and sesame based rural areas, although its contribution is slightly larger in the former than in the latter area (Table 6). Unlike this, income from butter sale had insignificant contribution as a cash source for residents of Gendawuha town (Table 6). This indicates that town residents used butter for home consumption than source of cash for household needs. In addition to these, families also used other sources of cash income, such as selling of water, monthly salary bases and income from daily wages. These sources had insignificant contribution as cash sources in the two rural communities than in Gendawuha town, which is to be expected as these commodities are more sellable in urban than rural areas.

In the interviewed farmers, selling of any commodity for the sources of cash in the household was dependent on the amount of money needed to cover their expense. For example, in most instances, respondents sell cattle to cover large expenses, where as they sell crop and/or butter for relatively smaller expenditures. However, butter and crop were used as a source of cash when there is a surplus from household consumption.

Table 5: Relative frequency of households in prioritization of commodities used as source of cash in Metema district.

Variables	*CBFS*		*SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Income sources:	N = 56		N = 175		N = 30		N = 261	
Live animals	56	100.0	172	98.3	29	96.7	257	98.5
Crop	56	100.0	164	93.7	29	96.7	249	95.4
Butter	41	73.2	80	45.7	2	6.7	132	50.6
Others***	1	1.8	8	4.6	5	16.7	14	5.4

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count,
***Others income sources includes selling of water, fruits, vegetable, monthly salary bases and income from daily wages.

Management of income from different commodities in Metema district is summarized in table 7. Considering the overall interviewed farmers, income obtained from crop sale was managed by both husband and wife (60.5%) or husband alone (34.0%). Lower proportion (5.5%) of sampled farmers reported that income from crop sale was managed by wife. This being the over all picture, notable differences observed when comparing the rural and urban residents. For example, the role of husband in managing cash income from crop sale was considerably high in cotton based (32.2%) and sesame based (40%) rural communities than in Gendawuha town where this aspect was almost entirely taken care by both spouses (Table 7). The same is true in managing cash income from animal sale. Both spouses participated in managing cash income from sell of animals in 69% and 53.5% of households in cotton based and sesame based rural areas, respectively, yet the sole participation of husband alone was quite considerable ,*i.e.*, 27.6% and 39.6%, respectively, in cotton based and sesame based systems

(Table 7). Unlike the two rural areas, in Gendawuha town, this aspect was almost entirely taken care by both spouses (93.1%) and the sole participation of husbands alone was quite negligible (6.9%).

Table 6: Gender participation in the management of income obtained from different sources in Metema district.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Income from crop sale:	N = 59		N = 165		N = 29		N = 253	
Husband	19	32.2	66	40.0	1	3.4	86	34.0
Wife	3	5.1	11	6.7	0	0.0	14	5.5
Both	37	62.7	88	53.3	28	96.6	153	60.5
Income from animal sale:	N = 58		N = 159		N = 29		N = 246	
Husband	16	27.6	63	39.6	2	6.9	81	32.9
Wife	2	3.4	11	6.9	0	0.0	13	5.3
Both	40	69.0	85	53.5	27	93.1	152	61.8
Income from butter sale:	N = 44		N = 83		N = 3		N = 130	
Husband	4	9.1	7	8.4	0	0.0	11	8.5
Wife	7	15.9	41	49.4	0	0.0	48	36.9
Both	33	75.0	35	42.2	3	100.0	71	54.6

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system

As opposed to the other sources, the role of wives in managing cash income from sell of butter is quite considerable and the role of participation of husbands alone is negligible. For example, both spouses participated in the management in 75% of cotton based and 42.2% of sesame-based households and yet wives alone taken care the income in 15.9% and 49.4% of the households, respectively in the mentioned rural areas. Where as, in Gendawuha town, this was again the job of both spouses in all households (Table 7).

In general, these findings elucidate the fact that the role of woman in handling and managing major cash sources can not be under estimated in Metema district compared to several societies and cultures in other parts of the country, particularly in highland areas, where woman possess decisive role in managing only minor income sources such as sell of eggs, chicken and butter. Where as, cash generated from major commodities such as sell of crops and larger animals (cattle and small ruminants) is entirely handled and managed by husbands alone (Ayantu, 2006).

4.2.4. Livestock holding and cattle herd structure

Livestock compositions of the sampled households in Metema district are presented in table 8. From the overall interviewed households, it can be seen that the livestock species observed in Metema district were composed of cattle (56.6%), goats (22.7%), sheep (4.1 %), donkeys (3.2%), camels (0.1%) and chicken (13.2%) (Table 8). However, the composition differed in the three areas. Cattle were more dominant in cotton based (60.6%) and sesame based (57.4%) than in Gendawuha town (47.6%). On the other hand, goats and sheep were found in greater proportion in the town than in the two rural communities (Table 8).

In Metema the genotype of cattle were entirely indigenous zebu cattle and crosses with temperate cattle breeds were totally lacking. The reasons why the sample farmers highly depended on indigenous cattle type were lack of technological awareness and inaccessibility of getting improved genotypes. As reported by the farmers, the indigenous cattle types dominantly found in Metema district were locally known as "*Agew"*, "*Simada"* and "*Fogera" crosses* and probably the naming referred to the places from where the cattle originated. In addition to these cattle types, minor proportions of "*Ruthana"* and "*Felata"* cattle types were

also available in the marginal areas of the district (Metema-Yohans, Shinfa, Gubay-Jejebit and Tumet-Menduka kebels). These two cattle types were believed to be native to Sudan and Niger, respectively.

Table 7: Livestock composition of the sampled households

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	Heads	%	Heads	%	Heads	%	Heads	%
Cattle	1113	60.6	2499	57.4	581	47.6	4193	56.6
Goats	379	20.6	954	21.9	353	28.9	1686	22.7
Sheep	14	0.8	184	4.2	107	8.8	305	4.1
Donkey	48	2.6	154	3.5	37	3.0	239	3.2
Camel	0	0.0	0	0.0	8	0.7	8	0.1
Chicken	284	15.5	562	12.9	135	11.1	981	13.2

HH = Household, SE = Standard error, * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

Mean cattle holding per household was significantly ($P<0.05$) higher in cotton based (18.55 heads/HH) than in sesame based farming system (13.88 heads/HH), where as mean holding in the former area was not significantly ($P>0.05$) different from Gendawuha town (Table 9, Appendix table 5). The fact that cotton based areas was inhabited for longer time than the recently resettled sesame based area may account to the relatively higher cattle holdings observed in the former than in the later. Gendawuha town is also located with in cotton-based system area and this again substantiates the observed large cattle holding in this town. The over all mean cattle holding per household in Metema district was 15.53±0.706 heads/HH and

this was higher than cattle holdings in most highland areas of the country such as in Mekele (8.01 heads/HH, Negussie, 2006) and Awassa area (6.85 heads/HH, Ike, 2002). Availability of vast communal grazing in Metema may account to higher cattle holdings than other areas.

Table 8: Cattle herd structure in the cotton based, sesame based farming system, and Gendawuha town. Mean values refer to average cattle holding per household shown by cattle age groups.

Herd	**CBFS*		***SBFS*		*Gendawuha*		*Overall*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Herd type:	N = 60		N = 180		N = 30		N = 270	
Breeding bulls	0.42	0.090	0.08	0.023	0.10	0.056	0.16[a]	0.027
Bullocks	1.75	0.180	1.49	0.133	1.97	0.376	1.60[b]	0.106
Oxen	1.39	0.140	1.74	0.128	1.73	0.500	1.87[bc]	0.107
Heifers	2.47	0.211	2.07	0.168	2.10	0.344	2.16[c]	0.127
Cows	5.23	0.354	4.31	0.267	6.6	1.046	4.8[d]	0.230
Calves	6.37	0.469	4.22	0.292	7.10	1.308	5.01[d]	0.272
Males	3.17	0.277	2.15	0.163	3.53	0.696	2.53	0.150
Females	3.20	0.254	2.07	0.167	3.57	0.388	2.49	0.150
Mean total cattle holding/HH	18.55[a]	1.070	13.88[b]	0.838	19.37[a]	3.041	15.53	0.706

Overall, mean holdings of each cattle type per household with same superscript do not significantly differ at 5 % level of significance. Similarly, total cattle holdings per household shown at the bottom of the table significantly differed in the two farming systems at 5% level of significance, while with different superscript differ significantly at 5% level of significance. * CBFS= Cotton based farming system, ** SBFS= Sesame based farming system, HH= Household, SE = Standard error

Out of the average total cattle holding per household cows (4.8 heads/HH) and [2]calves (5.01 heads/HH) were found significantly higher than the other herd types (Table 9). Following these heifers were found in considerable number (2.16 heads/HH), because households keep

[2] Calves were categorized in to two. First, the age between age at birth and 1½ years. Second, the age between 1½ and 3 years. Therefore, calves were composed of up to 3 years.

them for replacement purposes. Overall, there is a significant difference in herd composition of household cattle holding (F= 6.327, P= 0.000) (Appendix table 6). The dairy herd (cows, calves, and replacement heifers) dominated the cattle holding of households (Table 9). Oxen are also found in considerable number (1.87/HH) as the farmers need them for ploughing. Young intact bulls rather than steers are mostly demanded in markets across the border of Sudan and families keep intact young bulls without castrating them. Breeding bulls composed the least herd structure of households as there are shared among households in the community for breeding purpose. Overall, the proportion of cows (30.45%) out of the entire dairy herd is lower compared to the reported value for national average (42%) (Azage and Alemu, 1998). As opposed to the present work, lower proportion (24.3%) of cows was reported around Debre Birhan (Greysee, 1988). Calves are the other most important cattle herd group in the district. Farmers in study area ensured the replacement stock from the proportion of calves (32.29%) followed by heifers (13.90%). The proportion indicates that there is a good potential source for the replacement stock of the herds, which will be lost because of environmental stress and culling. Out of the total number of calves in the interviewed households, 683 (50.44%) were males, while 671 (49.55%) were female.

The distribution of dry and milking cows in cotton based, sesame based farming system and Gendawuha town areas are presented in table 10. The average milking cow holding in Gendawuha town (3.8±0.634) was higher than holdings in cotton based (3.3±0.261) and in sesame based (2.8±0.183) farming system areas. However, the differences were not statistically significant (P>0.05) (Appendix table 7).

Table 9: The distribution of dry and milking cows in cotton based, sesame based farming systems and Gendawuha town areas.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Condition of cows	Heads	Mean(SE)	Heads	Mean(SE)	Heads	Mean(SE)	Heads	Mean(SE)
	N=60		N=179		N=30		N=269	
Milking cows	200	3.3(0.26)[a]	501	2.8(0.18)[a]	113	3.8(0.63)[a]	814	3.0(0.15)
Dry cows	114	1.9(0.20)[a]	265	1.5(0.15)[a]	84	2.8(0.69)[ab]	463	1.7(0.14)
Total cows	314	5.2(0.35)	773	4.3(0.27)	197	6.6(1.05)	1284	4.8(0.23)

Mean holdings of cows per household with same superscript with in the same rows do not significantly differ at 5 % level of significance; while with different superscript differ significantly at 5% level of significance. * CBFS= Cotton based farming system, ** SBFS= Sesame based farming system, SE = Standard error

4.3. Experience and purpose of cattle rearing

Among farmers that had long experience of cattle rearing, proportionately greater percentage dwell in Gendawuha (83.3%) and in cotton based (74.6%) than in sesame based (62.6%) farming system (Table 11). By contrast, relatively fewer farmers had recent experience of cattle rearing in Gendawuha and in cotton based farming system than sesame based farming system. For example, 10.6% of sample farmers had < 3 years of experience in sesame based compared to 3.4% in cotton based farming system and none in Gendawuha town (Table 11). Like wise, 26.8% of sample farmers had 4-5 years of experience in sesame based compared to 22.2% in cotton based farming system and 16.7% in Gendawuha town (Table 11). This indicates that a cattle rearing is a relatively recent venture in sesame based than in cotton based farming system and Gendawuha town. As explained earlier, highlanders were settled first in cotton-based farming system areas and further advanced to Gendawuha town and sesame based farming system areas, as the former is relatively cooler than the latter areas. Even during

the survey time, new settlements were observed in different of sesame based farming system kebles.

Table 10: Household experience in cattle rearing (years) in Metema district.

Variables	*CBFS*		*SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Years started:	N = 59		N = 179		N = 30		N = 268	
1- 3 years	2	3.4	19	10.6	0	0.0	21	7.8
4-5 years	13	22.0	48	26.8	5	16.7	66	24.6
> 10 years	44	74.6	112	62.6	25	83.3	181	67.5

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

Overall, most farmers in Metema district had more than 10 years of experience in cattle rearing (67.5%). Relatively fewer farmers started cattle husbandry quite recently. For instance, 24.6% of sample farmers had 4-5 years of experience in cattle rearing and 7.8% had < 3 years of experience (Table 11). When the experience of households in cattle rearing was compared, significant difference were observed between the two farming systems ($\chi^2 = 8.329$, P = 0.016).

During the survey period, when respondents were asked about their experience of cattle husbandry, verbally they were responding as having long time experience, extending many generations back. Where as, when they were asked to convert this in to years, those that responded as having long experiences said more than ten years. This gave a notion that, a greater than 10 years of experience may refer to a much longer period than 10 years. Therefore, greater than 10 years of experience category would better be understood as a longer

period than what the figure shows. Nonetheless, such limitation was not observed regarding the shorter periods of experiences (< 5 years) as farmers were quite capable of recalling the shorter durations easily. In this regard, it was noted that the farmers were able to recall even the exact year since they started rearing was shorter than 5 years.

Major objectives of cattle rearing in Metema district is presented in table 12. According to the interviewed farmers, livestock were kept to fulfill multipurpose function, amongst of which the main functions were as a source of milk and milk products (48.9%), income (26.9%) and draft power (24.3%). On the other hand, the role of cattle to provide other commodities such as manure, meat, hide and skin were considered as secondary in the area.

Table 11: Major objectives of cattle rearing in cotton based, sesame based farming system and Gendawuha.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Major functions:	N = 60		N = 178		N = 30		N = 268	
Milk and milk products	38	63.3	89	50.0	4	13.3	131	48.9
Income source	8	13.3	42	23.6	22	73.3	72	26.9
Draft power	14	23.3	47	26.4	4	13.3	65	24.3

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system

4.4. Cattle management

4.4.1. Feed resources and feeding practices

Major feed resources used for cattle in Metema area were natural grazing (31.0%), crop residues (29.5%), crop aftermath grazing (21.8%) and hay (17.8%) (Table 13). As a matter of fact, difference in degree of utilization of these feeds among the three studied locations was trivial. In addition to the major feeds resources, farmers also used by-product feeds to a lesser extent, and these included local oil extract by-products (sesame cake), Niger seed cake and local brewery products. The result obtained in the study area were more or less comparable with the research conducted in the highlands of north and west Shoa zones, where natural grazing, crop residues and hay make the basal diet of livestock (Agajie *et al*., 2002).

Natural pasture

Natural pasture is the first and the most common feed resources used for all livestock species during wet and dry seasons. Natural pasture in the studied area was entirely communally owned. Farmers also provide their animals with leaves of trees locally called *chara* towards the end of the dry season during when the pasture deteriorate with in quality and quantity. During the group discussion, it was pointed out that the availability of livestock feed was influenced by season. For example, in wet season (June-November), households entirely depended on natural green pasture. This is because, in wet season, there was ample grazing pasture through out the district. Where as, in dry season (December-May), natural pasture dries up and becomes standing hay and animals graze up on this. Therefore, farmers during this time supplement their animals with hay, crop residues, tree foliage and to some extent with concentrates. As discussed above, tree foliage composed a significant portion of the livestock

feed towards the end of the dry season (beginning of the wet season) and to a lesser extent during the end of the wet season. In addition, almost in all parts of the district, burning of natural pasture is a common practice due to accidental and / or purposeful firing.

Table 12: Major feed resources in cotton based, sesame based farming system and Gendawuha town.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Major feeds:	N = 59		N = 176		N = 28		N = 263	
Natural grazing		33.7		31.2		27.5		31.0
Crop residues		28.0		30.7		27.5		29.5
Crop after math		21.1		20.0		27.5		21.8
Hay		17.1		18.2		17.6		17.8

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

Crop residues

As indicated in table 13, crop residues composed the second important feed source for livestock in Metema district. Sorghum stover is equally important in cotton based and sesame based farming systems and Gendawuha town (Table 14). This is because sorghum is one of the dominant crops produced in the three studied areas. Considerably higher proportions of Maize stover was used around Gendawha town (96.7%) and in cotton based farming system (66.7%), but its contribution was relatively low in sesame based farming system areas. Teff and millet straw were relatively less important as residue feeds compared to the stovers, but their contribution can not be underestimated in cotton based areas where these crops are produced to a considerable amount (Table 14).

Table 13: Types of crop residues used for livestock feeds in different studied locations.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Crop residues:	N = 60		N = 177		N = 30		N =267	
Sorghum Stover	60	100.0	176	99.4	30	100.0	266	99.6
Maize Stover	40	66.7	30	16.9	29	96.7	99	37.1
Teff straw	14	23.3	8	4.5	0	0.0	22	8.2
Millet straw	22	36.7	3	1.7	0	0.0	25	9.4

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Hay making

The experience of haymaking and reasons forwarded by the households for not practicing hay making in Metema are presented in table 15. The proportion of households that practiced hay making in sesame based farming system (70.9%) was lower compared to households in cotton based farming system (86.0%) and Gendawuha town (86.7%). The farmers were asked why haymaking was not practiced well and replied that higher proportion of inhabitants in sesame based farming system (48.0%) was due to lack of experience than in cotton based farming system (14.3%) and none in Gendawuha town. Overall, out of the total households interviewed, 75% of the sampled farmers exercised forage conservation in the form of hay, while 24.1% of sample farmers did not practiced haymaking. This shows that considerable proportion of households (one fourth) did not at all practice haymaking. Even among those who practiced haymaking, most of them produced small quantity of hay. On the other hand, there is usually excess pasture growth during wet seasons and since the natural pastures are

wide, the amount of pasture produced during the wet season is usually much more than the amount grazed by the animals.

Table 14: Experience of haymaking and reasons forwarded by the household for not practicing haymaking.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Experience of haymaking?	N=57		N=179		N=30		N=266	
Yes	49	86.0	127	70.9	26	86.7	202	75.9
No	8	14.0	52	29.1	4	13.3	64	24.1
Reasons, not practicing hay making:	N=7		N= 50		N =3		N = 60	
Lack of experience	1	14.3	24	48.0	0	0.0	25	41.7
No feed shortage	1	14.3	4	8.0	0	0.0	5	8.3
Availability of stand dried hay	4	57.1	16	32.0	0	0.0	20	33.3
Large size of herd	0	0.0	3	6.0	0	0.0	3	5
Purchase from others	0	0.0	2	4.0	3	100.0	5	8.3
Shortage of labor for hay making	1	14.3	1	2.0	0	0.0	2	3.3

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

As shown in table 15, the main reasons why the farmers did not practice hay making were lack of experience (41.7%) and availability of stand dried hay (33.3%). The latter reason may appear convincing, however the quality of stand dried hay is much inferior than hay produced by cutting the herbage at the right stage of maturity. As a result, if farmers are given the necessary training, a lot of the pasture can be conserved in to hay rather than left to dry up in to low quality standing hay, which eventually is burned and wasted, as it is the case in all parts of the district. So due consideration should be given to accustom the farmers to hay making as it can substantially improve the feeding situation of livestock during the dry season. It is even

important to go beyond providing farmers with simple illustration of haymaking practice and help them to have access to the use of machinery that can mow and carry the mowed grass from distant communal pasture to homestead. It is probably lack of this kind of tool, which hindered the practice of large-scale haymaking, despite the availability of excess pasture in the wet season. Since the resource base is available in the area (cattle, pasture), if such a technology could be introduced to the community (either in the form of credit) , it is possible to boost up cattle husbandry as farmers become encouraged to expand their holdings and eventually specialize in to large scale commercialized producers.

Concentrates and mineral leak

During the group discussion, it was pointed out that concentrates used in the area were oilseed cake (purchased from Gondar town), sesame cakes (by-products of local oil extraction) and sorghum seed (roasted and none roasted). In general, concentrates were given to emaciated dairy cattle (cows, calves) and to cattle that were fattened in newly established smallholder-fattening farms (oxen, steers).

Mineral salt was commonly given for livestock in wet season. However, as reported by the sampled farmers, because of the hot climate and the scarcity of forage resources, animals were not given salts during the dry season. As gathered from key informants, salt is given to enhance feed consumption, initiate cows to be in heat and increase milk production. The frequency of providing salt for livestock depended on the capacity of the households and it ranged between 15 and 30 days.

4.4.2. Source of water

River (running water) is the main sources of water for livestock (88.8%) in Metema area than other sources (Table 16). On the other hand, river water users were proportionately less in cotton based areas than in the other two sampled locations. According to farmers report, rivers used in cotton based farming system are mostly ephemeral and dry up early during the dry season. Thus, there is critical shortage of water sources in this farming system, and households alleviate the problem by digging wells. As a result, considerable proportion of inhabitants (26.7%) in cotton based areas used wells water as compared to those in sesame based farming system (10.2%) and Gendawuha town (6.7%) (Table 16). In sesame based farming system, although the rivers are ephemeral, most areas are flat plain and the drying rivers leave behind ponds that remain active for extended period and can be used as water sources during most of the dry season. Nonetheless, water shortage is critical in both farming systems during the dry season.

The overall result showed that out of the total number of sampled respondents (N=269), 67.7% responded as there was no water problem, where as the rest (32.3%) responded as there was water problem during the dry season (Table 16). Comparing the three areas, nearly half of the respondents in cotton based areas responded as experiencing water shortage while the proportions were about one in three and one in four for the sesame areas and Gendawuha town, respectively (Table 16). This indicates that water shortage was critical in cotton based areas, although the problem prevail in all the three areas

Table 15: Sources of water for livestock in CBFS, SBFS and Gendawuha town.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Water scarcity?	N = 59		N= 180		N = 30		N= 269	
Yes	28	47.5	53	29.4	6	20.0	87	32.3
No	31	52.5	127	70.6	24	80.0	182	67.7
Source of water:	N = 60		N = 176		N = 30		N = 266	
River	44	73.3	165	93.8	30	100.0	239	88.8
Wells	16	26.7	18	10.2	2	6.7	36	13.4
Tap water	1	1.7	7	4.0	0	0.0	8	3.0
Pond water	0	0.0	6	3.4	0	0.0	6	2.2

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

Overall, the majority (90.5%) of households were provided water for livestock once a day in wet season, while lower proportion of households provided water twice a day (Table 17). Where as in dry season, the majority (69.2%) of households provided water twice daily and 19.4% and 11.5% watered their animals once and three times per day, respectively (Table 17). Most of the households expressed unreliability of river water as rivers tended to dry during the dry season. The overall average distance to watering points from the camping area was 3.1±0.15 km (Table 17).

Table 16: Frequency of watering cattle in different areas of Metema district.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Wet season:	N = 57		N = 155		N = 30		N=242	
Once a day	45	78.9	147	94.8	27	90.0	219	90.5
Twice a day	12	21.1	8	5.2	3	10.0	23	9.5
Dry season:	N = 57		N=166		N=30		N=253	
Once a day	0	-	46	27.7	3	10.0	49	19.4
Twice a day	36	63.2	113	68.1	26	86.7	175	69.2
Trice a day	21	36.8	7	4.2	1	3.3	29	11.5
distance in km (SE):	2.3(0.22)		3.4(0.19)		3.3(0.46)		3.1(0.15)	

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

4.4.3. Housing system

The experience of housing for different livestock species in Metema district is presented in table 18. In Metema district, all farmers used open fenced barn that did not have roofing to shelter larger livestock like cattle (except calves), camel and donkey during night time . On the other hand, most of the farmers (95.5%) kept their calves and small ruminants in closed barns that had roof cover (Table 18). The latter types of houses were separate huts in which the upper part of the wall was entirely open sided for maximum ventilation and the roof was made of grass tachet. The floor of the house was simply compacted soil or earthen floor with out any kind of pavement. Provision of closed barns for calves and small ruminants varied from place to place. Overall calves were most favored (92.6%) in getting roofed night time shelter followed by goats (57.8%), while sheep were least favored, i e., only 9 % of the households provided this type of night shelter for sheep (Table 18) .

According to the interviewed farmers, sheep can tolerate chills conditions as well as rain than goats or calves and can be kept in roofless fenced barn together with larger livestock during night time. Regarding the reasons for not using roofed shelter for larger livestock, majority of respondents (72.4%) said that they did not accustomed to keep larger livestock in roofed houses, some 16% also said that they are not stationed in a fixed location to provide permanently fixed closed barn while few (7.1%) replied that such kind of housing make the animals hardy and tolerant to harsh situations, which they may face when they are moved to distant pasture grounds. Still there were few (3.7%) who replied as having large herd and could not afford roofed houses for all animals (Table 18).

Table 17: Proportion of households that provided closed barn for calves and small ruminants and reasons for not providing closed barns for larger livestock.

Variables	[*]*CBFS*		[**]*SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Housing experience?	N=59		N=178		N=30		N=267	
Yes	56	94.9	171	96.1	28	93.3	255	95.5
No	3	5.1	7	3.9	2	6.7	12	4.5
Housing livestock species:	N=56		N=172		N=28		N=256	
Calves		54.4		61.2		48.9		58.1
Goats		45.6		31.4		42.6		36.3
Sheep		0.0		7.4		8.5		5.6
Reasons for not using closed barns for cattle :	N=60		N=178		N=30		N=268	
Large number of cattle	8	13.3	1	0.6	1	3.3	10	3.7
No fixed location	13	21.7	32	18.0	0	0.0	45	16.8
hardy and resistant	10	16.7	8	4.5	1	3.3	19	7.1
Not accustomed	29	48.3	137	77.0	28	93.3	194	72.4

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

4.4.4. Breeding system

Farmers in the studied areas reported that breeding system was entirely natural mating using local type bulls available in the area. Usage of AI service or exotic breed bull station that provide breeding bull service were entirely lacking due to the absence of technological intervention to introduce foreign (improved) breed in the area. Over all, 65.8% of the farmers had intention and excersized practicing to select bulls for breeding and the rest one third left their cows for open mating with no concern for selecting bull however, variations exist from area to area (Table 19). More households (75.0%) in cotton based farming system practiced in bull selection than in sesame based farming system (64.8%) and Gendawuha town (53.3%). In households that practiced selective mating, the criteria were milk yield, body conformation, color and breeding potential (listed in the order of importance) (Table 19).

Proportionately more inhabitants used their own bull for breeding in cotton based farming system (47.1%) than Gendawuha town (26.5%) and sesame based farming system (19.2%) (Table 19). On the other hand, proportionately more households either borrowed neighbor's bull or relied on open mating in sesame based area (45.2% and 35.6%, respectively) and Gendawuha town (29.4% and 44.1%, respectively). Usage of own breeding bull for mating purpose may be associated to the size of cattle holding. According to key informants, households that possessed large cattle holdings afforded their own breeding bull. In general, overall result showed that most of the inhabitants (73.0%) in Metema district did not have their own bulls. Thus, they relied on bulls that belonged to their neighbors from the village (39.5%) or left their cows for open mating at communal grazing (33.5%). As gathered from farmers, charging for breeding bull service is uncommon in Metema district.

Table 18: Proportion of households that practiced selective mating and source of breeding bull in the three studied areas of Metema

Variables	*CBFS**		*SBFS***		*Gendawuha*		*Overall*	
	HH	%	HH	%	HH	%	HH	%
Types of natural breeding:	N = 60		N = 179		N = 30		N = 269	
Select bull	45	75.0	116	64.8	16	53.3	177	65.8
No selection	15	25.0	63	35.2	14	46.7	92	34.2
Sources of bull:	N = 60		N = 177		N = 30		N = 267	
Own	33	47.1	34	19.2	9	26.5	76	27.0
Neighbors	22	31.4	80	45.2	10	29.4	111	39.5
Open mating	15	21.4	63	35.6	15	44.1	94	33.5

* CBFS= Cotton based farming system, ** SBFS= Sesame based farming system, HHC = Household count

The type of indigenous breed bull preferred for mating and reasons for discriminating one against the other are summarized in table 20. Proportionately more inhabitants (15.2%) in sesame based farming system preferred Ruthana (Sudan origin) cattle type for breeding than in Gendawuha town (6.7%) in order to get traits like milk yield, large frame size, traction power, where as there was no inhabitants in cotton based farming system preferred Ruthana cattle. This is because of the availability of Ruthana cattle in sesame based farming system gives a chance to be well awared by the residents (Table 20).

Table 19: Preferences among available local breed bull for mating and reasons for discriminating one type against the other, as viewed by respondents in the three studied areas of Metema.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Preferred local breed bull:	N = 60		N = 178		N = 30		N = 268	
Ruthana(Sudan origin)	0	-	27	15.2	2	6.7	29	10.8
Other than Ruthana	34	56.7	33	18.5	4	13.3	71	26.5
Any available locals	26	43.3	118	66.3	24	80.0	168	62.7

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

Results from the group discussion indicated that milk yield potential, body framework, color and behavior were used alternatively as a selection criterion for the breeding bull. Red, white, mixture of red and white colors were highly selected, where as black color was not selected for breeding purpose. A breeding bull, which has big frame size, good behavior for management and good milk producing ability was selected for breeding. How ever, a breeding bull, which has low milk producing heredity, could be selected if it has a good body framework and attractive color.

Season of breeding

Reports from group discussion showed that cattle breeding (conception, calving) was highly dependent on the season of the year. The month from June to August coincided with wet season during when abundant and nutritious fodder is available in the natural pasture. Where as, January to May is a dry period, when the natural pasture dries up and become poorly nutritive, particularly deficient in nitrogen content. Thus, the reproductive pattern of cows

followed the seasonal pattern of rainfall, which tended to influence nutrition. Therefore, in most instances, cattle in dry season do not come in heat because of feed shortage and environmental stresses (hot environmental condition). At the onset of rains, grasses and leaves of plants start to revive and the improved feeding situation initiate heifers and cows to be ready for breeding. As a result, the time June, July and August marked the months of heightened breeding in the studied areas followed by September to December, although the intensity of breeding activity was reduced during the latter period.

4.4.5. Disease and health management

Major cattle diseases in cotton based, sesame based farming system and Gendawuha town is presented in table 21. Out of the total households sampled, 86% reported disease occurrence as a major problem of cattle production in the area (Table 21). However, the intensity and type of diseases varied from area to area. Proportionately more households (94.9%) reported disease occurrence in cotton based than in Gendawuha town (86.2%) and in sesame based farming system (83.8%) and the difference is nearly significant (χ^2 = 3.6, P = 0.06). Inhabitants in cotton based farming system areas complained that the transhumant from the highland areas during their entry and exit could have a chance of disease transmission to their cattle and this way explain the reason why high disease incidences was observed high prevalence in cotton based compared to the other two areas.

Table 20: Major cattle diseases in the three studied areas of Metema district.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Disease occurrence:	N = 59		N = 179		N = 29		N = 267	
Yes	56	94.9	150	83.8	25	86.2	231	86.5
No	3	5.1	29	16.2	4	13.8	36	13.5
Type of diseases:	N = 56		N = 150		N = 25		N = 231	
Ticks infestation	9	16.1	60	40.0	17	68.0	86	37.2
Babesiosis(Demashegne)	32	57.1	41	27.3	0	0.0	73	31.6
Foot and Mouth Disease	7	12.5	26	17.3	3	12.0	36	15.6
LSD(Yezhonewetete)	5	8.9	11	7.3	0	0.0	16	6.9
Black leg(Mitch)	3	5.4	9	6.0	1	4.0	13	5.6
Trypanosomosis(Gendi)	0	0.0	0	0.0	4	16.0	4	1.7
Mastitis(Teat problem)	0	0.0	2	1.3	0	0.0	2	0.9
Oedema	0	0.0	1	0.7	0	0.0	1	0.4

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Based on the over all data, three types of diseases were identified as major health problem of cattle in Metema district and these involved tick infestation (37.2%), babesiosis (31.6%), Foot and Mouth Disease (FMD) (15.6%) (Table 21). In addition, other diseases reported with minor degree of importance includes, Lumpy Skin Disease (LSD) (6.9%), blackleg (5.6%), trypanosomosis (1.7%), mastitis (0.9%) and oedema (0.4%). This being the over all situation, notable differences were observed regarding the type of diseases prevailing in the three areas. For example, considering the major diseases, babesiosis was reported as the major threat in cotton based areas (57.1%) and to a considerable extent in sesame based (27.3%), where as no occurrence of this disease was reported in Gendawuha town (Table 21). On the other hand, tick infestation was a major problem in Gendawuha town (68.0%) and sesame based areas

(40.0%) than in cotton-based areas (16.1%). The occurrence of FMD was fairly comparable in the three areas.

In order to minimize the economic losses due to diseases, farmers used different control and prevention measures for most of the diseases, as summarized in table 22. Most farmers (96.7%) in Gendawuha town had access to clinic services and nearly half of the farmers in sesame-based areas had this privilege. On the other hand, very insignificant proportion of the farmers (1.7%) in cotton-based areas got access to vet clinics (Table 22). As a result, farmers in cotton-based areas mostly got medicine from MOA (61%) or private sources (22.0%). In sesame-based areas, majority (50.9%) obtained medicine from private sources and the rest from clinics (22.3%) or used cultural medicine (20%) to threat sick animals. In Gendawuha town, the majority (50%) used clinic service and about one fourth (27.8%) relied on cultural medicine (Table 22).

Veterinary medicine from private sources, come from the distribution of legal and illegal veterinary medicine supply and there is a large stock of such medicaments in Gendawuha town and other small town in sesame based farming areas such as, Kokit, Shinfa and Metema-Yohans kebles. Overall, most of the households (71.4%) in Metema district were supplied veterinary medicine from private sources, while lower proportion of households (28.6%) were supplied from MOA sources.

As indicated in table 22, considerable proportions of farmers (17.8%) in Metema district were using cultural medicine to treat sick animals. As gathered from key informants, cultural

treatment mostly involves plant extracts administered differently depending on the type of disease. For example, blackleg (mitch) was treated by orally given grinded root of some selected plant species by dissolveing in water. Parasitic diseases of cattle are treated with *Aloe pirottae* leaf mixed with salts and given orally. Calf diarrhea is treated with branding different body parts of calves and it is believed that the disease is scared away.

Table 21: Disease control strategies in Metema district.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Solution for the problem:	N=56		N=151		N=26		N=233	
Medicine from private source	13	22.0	89	50.9	3	8.3	105	38.9
Get clinic service	1	1.7	39	22.3	18	50.0	58	21.5
Cultural medicine	3	5.1	35	20.0	10	27.8	48	17.8
Medicine from MOA	36	61.0	4	2.3	2	5.6	42	15.6
Branding	6	10.2	8	4.6	3	8.3	17	6.3
Is there clinic service?	N=60		N=177		N=30		N=267	
Yes	1	1.7	85	48.0	29	96.7	115	43.1
No	59	98.3	92	52.0	1	3.3	152	56.9

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

There are governmental veterinary clinic and lately started private veterinary drug vendors at Gendawuha town. Governmental clinics were categorized in to main clinic, satellite clinic and paravets. There was one main clinic located at Gendawuha town and two-satellite clinics located at Shinfa and Kokit Kebles, while the paravets were located at some other Kebles' of the district. Government clinic provides veterinary examination and treatment at the clinics. In addition, the clinic provides vaccination services moving from Keble to Keble when there is disease outbreak. The paravets at Keble level provide veterinary service at their village. The

paravets were trained and supplied with drugs and vet equipments with the assistance of Integrated Livestock Development Project (ILDP) project.

During group discussion, it was pointed out that livestock health problem was not fully addressed, because of inadequate veterinary service provided through out the district. Government officials in the district also anticipate the problem and attribute it to shortage of veterinary expertise and related facilities. Since disease is one of the major threats of livestock production in the district, livestock health management in Metema district as a whole needs due attention.

4.4.6. Waste management

Inhabitants in Gendawuha town (76.6%) and majority (56.7%) in cotton based farming areas utilize manure for different purposes, where as the proportion that utilizes manure in sesame-based areas (39.35) was less (Table 23). Maize and pepper are mostly produced in cotton based farming system areas and around Gendawuha town and these two crops need soil, which is fertilized with manure. As a result, manure was efficiently utilized in these two areas than in sesame-based areas. Overall, most of the inhabitants (52.6%) in Metema district did not use manure for fertilization or other purposes such as fuel source (Table 23).

Over all data in table 23 shows that among farmers that make use of cattle dung, 83.2% the produced manure was used as manure fertilizer, while insignificant proportion was used as fuel (1.3%) or other purposes (2.6%). Thus, even among the users, 12% of the produced manure was wasted. In general, manure in the studied areas seems unimportant and wasted because of the availability of easily accessible fuel wood as well as farmers rely on its natural fertility of

the soil. According to key informants, the natural fertility of the soil has not been exhausted. Thus, with the exception of crops like maize and pepper, farmers do not normally apply manure for crops like cotton or sesame. In the latter case, farmers usually abstain farming for 1-3 years to rehabilitate soil when the yield decreases.

Table 22: Manure utilization in cotton based, sesame based farming system, and Gendawuha town.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Use of manure:	N=60		N=178		N=30		N=268	
Yes	34	56.7	70	39.3	23	76.7	127	47.4
No	26	43.3	108	60.7	7	23.3	141	52.6
Manure utilization (%):	N=34	Mean(SE)	N= 68	Mean(SE)	N=23	Mean(SE)	N=125	Mean(SE)
Fertilizers		90.9(1.76)		74.4(4.65)		97.8(2.17)		83.2(2.74)
Fuels		1.2(0.70)		1.8(1.49)		-		1.3(0.84)
Others use		7.9(1.78)		0.8(0.74)		-		2.6(0.69)
No values		-		21.3(4.34)		2.2(2.17)		12.0(2.56)

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

During the group discussion, it was pointed out that manure was removed once a day, in the morning after milking and moving the cattle to the back yard. At times animals were intentionally stationed in fenced back yard farms to fertilize the field. In such instances and when animals were moved to far away communal grazing pastures, the open barn that had been used as a night shelter was simply changed to a different place instead of cleaning it (Figure 2).

Figure 2 : Open fenced crash for large ruminant around the homested. A in the above picture shows the newly fenced crash for the coming days, while B shows the fertilized back yard for some number of days before.

4.4.7. Labor allocation for different cattle husbandry practices

Labor allocation involved in cattle herding, barn cleaning, milking, fermented milk churning and butter selling in Metema district are summarized in table 24. In Gendawuha town, herding was mainly performed by hired labor as compared to cotton-based and sesame based farming system, in which this activity mostly taken care by male children and/or husbands (Table 24). This is probably because of the town residents afford to pay for hired labors than farmers in rural communities. During the group discussion, it was pointed out that most of the farmers in the area used hired labor for livestock herding during wet season. This is perhaps due to family labor is engaged in other agricultural activities. On the other hand, since most of the crops are harvested during the dry season, household heads also participate in herding. Overall, herding is more of hired labor responsibility (46.7%) than male children and/or husbands. As opposed

to the present work most of the livestock herding was performed by family labor (boys and daughters), reported by Belete (2006).

Barn cleaning was proportionately more of wives' duty (57.1%) in sesame based farming system than in cotton based farming system (32.4%) and Gendawuha town (30%). On the other hand, the participation of male children, husband and hired labor was greater in cotton based farming system and in Gendawuha town than in sesame based farming system (Table 24). Overall, barn cleaning was mostly performed by wives (37.6%) followed by female children (25.6%) and male children (17.3%). The involvement of husbands (10.5%) and hired labor (9.0%) was relatively less (Table 24).

Considering the over all data, milking was largely performed by husbands (44.7%) followed by wives (28.0%), where as the involvement of male children (17.9%) and hired labor (9.5%) was comparatively less (Table 24). During group discussion, it was pointed out that females participated in milking, if the cows were in the vicinity of the homestead, other wise it was performed by other household members of the family. Churning milk was largely the duty of wives (52.9%) and female children (26.1%) and the involvement of husbands, male children or hired labor was insignificant (Table 24).

Butter selling majorly involved wives (55.1%) and to some extent husbands (25.6%), where as children were seldomly engaged in this duty (Table 24). Butter is not frequently sold in bits, rather it is stored and sold out in bulk during major holidays particularly during Easter. The

regular selling activity (in bits) is usually taken care by wives and husbands involve during bulk sale.

Table 23: Labor allocation for different cattle husbandry activities in Metema district.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Livestock herding:	N = 23		N=35		N = 30		N=88	
Hired labor	5	16.7	14	32.6	30	93.8	49	46.6
Male children	14	46.7	16	37.2	2	6.3	32	30.5
Husband	11	36.7	13	30.2	0	0.0	24	22.9
Barn cleaning:	N = 16		N=23		N = 28		N=67	
Wife	13	37.1	16	57.1	21	30.0	50	37.6
Female children	8	22.9	8	28.6	18	25.7	34	25.6
Male children	5	14.3	1	3.6	17	24.3	23	17.3
Husband	6	17.1	2	7.1	6	8.6	14	10.5
Hired labor	3	8.6	1	3.6	8	11.4	12	9.0
Family members involved in milking:	N = 23		N=33		N = 30		N=86	
Husband	21	58.3	29	49.2	30	41.1	80	44.7
Wife	8	22.2	12	20.3	24	32.9	44	26.2
Male children	4	11.1	11	18.6	12	16.4	27	16.1
Hired labor	3	8.3	7	11.9	7	9.6	17	9.5
Family members involved in Churning:	N = 23		N=36		N = 29		N=88	
Wife	23	67.6	36	55.4	26	48.1	85	55.6
Female children	8	23.5	16	24.6	16	29.6	40	26.1
Male children	0	0.0	6	9.2	3	5.6	9	5.9
Husband	2	5.9	4	6.2	4	7.4	10	6.5
Hired labor	1	2.9	3	4.6	5	9.3	9	5.9
Butter selling:	N = 6		N=39		N =3		N=48	
Wife	5	62.5	36	53.7	2	66.7	43	55.1
Husband	3	37.5	16	23.9	1	33.3	20	25.6
Male children	0	0.0	8	11.9	0	0.0	8	10.3
Female Children	0	0.0	7	10.4	0	0.0	7	9.0

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count. The percentage was calculated from the frequency of households.

4.5. Productive and reproductive performances of dairy cattle

Milk yield

Average daily milk yield produced per cow in sesame based farming system (2.01±0.058) and in Gendawuha town (2.1±0.092) were significantly higher (P<0.05) than in cotton based farming system (1.4± 0.052) (Table 25, Appendix table 8).

The overall average milk off-take of indigenous cows in the study area was about 1.9± 0.045 liter/cow/day (Table 25). As indicated in the methodology section, empirical record was taken from selected cows regarding the volume of milk produced during the wet season. Based on the empirical recorded data the average volume of milk off take/cow/day estimated as 2.5±0.17 liters and had a difference of 0.6 liter with the estimate of farmers. This shows that the average estimate derived from the survey data did not seriously deviate from the estimate obtained from empirically recorded data. Thus, the survey data can be considered as a reasonable approximation and fairly dependable result. The value obtained in the current study is more or less comparable with the average daily milk off-take of local cows was 2 liters (Brokken and Senait, 1992). By contrast, Lemma *et al.* (2005) reported lower average milk off-take (1.0 liter) for local Arsi cows in East Shoa Zone of Oromia.

The average lactation yield obtained in Gendawuha town (590.5±37.028) was significantly (P<0.05) higher than in sesame based (314.7±9.838) and in cotton based farming system (217.7±10.305). In addition, the difference between the latter two areas was significant (Table 25, Appendix table 8). The over all average lactation yield of indigenous cows in the studied area was 324.0±10.274 liters (Table 25). The value obtained in the current study is more or

less comparable with the average value reported by Ababu *et al*. (2004) for locals (399.5 liters/cow/lactation) in Degem district. By contrast, Azage and Alemu (1998) reported lower national average lactation yield (213kg) for indigenous cows. Also the present estimates for Metema area are smaller than the average lactation yield of 672 of kg reported for Barca breed (Million and Tadelle, 2003).

Table 24: Productive and reproductive performance of indigenous cows in Metema district.

	*CBFS		**SBFS		*Gendawuha*		*Overall*	
Variables	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)
DMY(liter)	60	1.4(0.05)^{a}	177	2.0(0.06)^{b}	30	2.1(0.09)^{b}	267	1.9(0.05)
LY(liter)	60	217.7(10.31)^{a}	173	314.7(9.84)^{b}	30	590.5(37.03)^{c}	263	324.0(10.27)
LL(month)	60	5.4(0.18)^{a}	175	5.5(0.15)^{a}	29	9.5(0.45)^{b}	264	5.9(0.14)
AFC(year)	60	4.8(0.08)^{a}	174	4.4(0.04)^{b}	30	4.5(0.12)^{ab}	264	4.5(0.04)
CI(month)	60	17.8(0.49)^{a}	173	17.3(0.38)^{a}	29	22.5(1.03)^{b}	262	17.9(0.31)
WA(month)	60	7.8(0.39)^{a}	173	10.1(0.32)^{b}	30	13.0(1.25)^{c}	263	9.9(0.28)
CC(No)	60	5.9(0.28)^{a}	169	7.9(0.14)^{b}	30	8.4(0.28)^{b}	259	7.5(0.13)

Productive and reproductive performances of local cows with same superscript with in the same rows do not significantly differ at 5 % level of significance. * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count, DMY = Daily milk yield, LY = Lactation yield, LL = Lactation length, AFC = Age at first calving, CI = Calving interval, WA = Weaning age, CC = Calf crop

Lactation length

As indicated in table 25, average lactation lengths of local cows in cotton based (5.4±0.178 months) and in sesame based farming system (5.5±0.146 months) were comparable but these values were significantly ($P<0.05$) less than the average value found for cows in Gendawuha town i.e., 9.5±0.446 months (Table 25, Appendix table 8). The overall average lactation

length of indigenous cows in the studied areas was 5.9±0.14 months and it ranged from 2 -12 months. Farmers in the studied areas allow calves to keep on suckling after terminating milking. Thus, the average length of time in which calves were suckled was 10.43±0.27 months (range 4-24 months) and it is nearly twice the length of milking time. The average lactation length value obtained in the present study (5.9±0.14) is more or less comparable with the values reported by Mulugeta *et al.* (1993) and Ababu *et al*. (2004), for local cows at Bako research centre (6 months) and north west shoa area (183 days), respectively. According to farmers, the shorter lactation length of cows obtained in the present study could be attributed to the short rainy season (contributing to shortage of feeds), infestation of biting flies and hotter environmental condition prevailing in the study areas. As opposed to the present work, research conducted in East Shoa Zone of Oromia indicated that lactation length of local cows varied from 5 to 12 months with an average of 9.5 months (Lemma *et al.,* 2005). Other higher values (450 days) for the Friesian-Boran crossbred cows of Cheffa farm (Oromia) was reported (Gebeyehu and Hegde, 2003). Similar higher result (474 days) for cows with 7/8 and 15/16 Friesian inheritance was reported (Gebeyehu, 2005). Similarly Mureja *et al*. (2002) reported higher values of mean lactation length (351 days) for Holstein Friesian cattle at Holetta dairy farm.

Weaning age

As indicated in table 25, the average weaning age of calves in Gendawuha town was significantly ($P<0.05$) higher than the average weaning age values obtained in cotton based and sesame based farming system but differences between the latter two was comparable

(Table 25, Appendix table 8). The overall weaning age of calves in the studied area was 9.9 ± 0.283 months (Table 25).

Age at first calving (AFC)

As indicated in table 25, mean AFC of cows in cotton based farming system was significantly ($P<0.05$) higher than in sesame based farming system, while that of cows in Gendawuha town was comparable with cows in both cotton based and sesame based farming system areas (Appendix table 8). The overall mean age at first calving of local cows in Metema district was 4.54±0.05 years and it is more or less comparable with a report from Mali where the mean age at first calving was 49.5±3.34 months (Wilson, 1986). On the other hand, lower values of AFC have been reported for indigenous cattle (44 months) and exotic cattle (34 months) else where in the tropics (Mukasa-Mugerwa, 1989). Moreover, the value obtained in the present work was higher than the respective values of 47.61 months for local Fogera cows and 40.61 months for F1 crosses of Fogera and Holstein Friesian at Metekel ranch (Addisu and Hegede, 2003). Similarly, based on a study conducted at Andassa Cattle Breeding and Improvement Ranch (ACBIR) reported a lower overall mean age at first service (AFS) value of 40.6±8 months for Fogera breed (Gebeyehu *et al*., 2005). By contrast, higher values of age at first conception was reported for Boran x Holstein- Friesian F1 crossbred dairy cows (53.9 months) at Abernosa Ranch (Ababu *et al*., 2006), which gave a mean AFC value considerably higher than the values obtained in the present study for locals in Metema district. Gizaw *et al.* (1998) also reported higher mean values of AFC (60 months) for Horro cattle on farm level.

Calving interval (CI)

As indicated in table 25, in the present study, calving interval significantly differed ($P<0.05$) in the three areas (Appendix table 8). The mean calving interval of cows in cotton based farming system and sesame based farming system areas was comparable but the mean value for cows in Gendawuha town was significantly ($P<0.05$) higher than the values obtained in the two rural areas of Metema (Table 25). This is perhaps because of the higher lactation length observed in Gendawuha town than the other two farming system areas. The overall mean CI of indigenous cows in the studied area was 17. 97±0.313 months (Table 25). The value obtained in the present work was comparable to the result reported for Zebu cattle as ranging between 12.2 and 26.6 months (Radostits *et al.,* 1994; cited in Gifawosen *et al*., 2003). Similarly, the present finding was comparable to the average calving interval of Boran x Holstein- Friesian F1 crossbred dairy cows (534.5 days) in Abernosa Ranch (Ababu *et al*., 2006).

By contrast, the overall mean CI of local cows in Metema was higher than the respective values of 12.2 months reported for Horro and 12.9-15.1 months reported for Arsi cattle type (Mukasa-Mugerwa, 1989). On the other hand, mean CI of locals in Metema area found in the present study was lower than the value (665±202.2 days) reported for locals in Mali (Wilson, 1986). Also higher values of CI than the present result were reported for Fogera cows (559 days) at Metekel ranch (Addisu and Hegede, 2003) as well as for local cows in Degem district, ie., 563 days (Ababu *et al*., 2004).

Lifetime calf crop

As shown in table 25, the mean calf crop number in sesame based farming system and Gendawuha town was comparable but it was significantly higher ($P<0.05$) than the mean calf

crop values obtained in cotton based farming system areas (Appendix table 8). The overall mean calf crop number for the indigenous cows in the studied areas was 7.52± 0.128 heads (Table 25). As opposed to the present work, lower values of overall mean lifetime calf crop (3.58) was recorded at Cheffa farm in Oromia (Gebeyehu, 2005). Similar studies in Ethiopia showed that local cows that had 50%, 75% and 87.5% blood level of Holstein Friesian on the average produced 4.7, 3.4 and 2.0 calves in life time, respectively (Ababu *et al*., 2004). More over, Ababu *et al.* (2004) reported average calf crop of locals in Degem district, as 4.1 calf/cow, which is lower compared to the average value for locals in Metema found in the present study.

4.6. Milk and milk handling practices

4.6.1. Milking practices

Despite the presence of considerable goat and camel population in Metema district (Table 8), farmers milked and used only cow's milk. By contrast, most pastoralists in such lowlands and marginal areas else where in the country are accustomed to use goat and camel milk. The reason why the studied communities were not familiar with using goat and camel milk could be the fact that they were descendants of highlanders who were unaccustomed to raising camel and goats for milking purpose and thus unfamiliar to use milk from these animals. This may explain the fact that the highland migrants did not live long time in Metema to become accustomed to use the milk of goats, which is a common milk animal in the lowland.

Farmers reported that milking in Metema district was performed two times a day *i.e.*, during morning and evening hours. Morning milking took place between 6:00 and 7:00 o'clock,

before biting flies affecting the cows. Where as, evening milking took place between 18:00 and 20:00 o'clock after flies stops biting the cows. The present result is in agreement with the result in East Showa, where milking takes place twice a day (Lemma *et al*., 2005). As opposed to this Ayantu (2006) noted that milking was commonly done three times per day around Wolayta.

The type of milking system in Metema district was entirely hand milking (Table 26). Overall, most households practiced once partial suckling (77.1%) than twice-partial suckling (9.9%) while milking their cows, however this varied from place to place (Table 26). For example, more inhabitants in sesame based farming system practiced once-partial suckling (88.5%) than in cotton based farming system (69.0%), where considerable proportion also practiced twice-partial suckling (20.7%) than in the former area. In case of Gendawuha town, most farmers (73.3%) used both systems, while some (26.7%) still practiced once partial suckling method during milking (Table 26). Unlike such observable differences, interviewed farmers believed that this practice is not linked to location differences, it is rather related to the custom of individuals in extracting as much more milk as possible. Individuals that practiced twice-partial suckling reason out that some cows stop letting down milk and retain for their calves, if they are suckled once and milked. Thus, they argue that suckling once more in between initiates the cows to release more milk, which they holdback for the calves.

Table 25: Milking system practice in cotton based, sesame based farming system and Gendawuha town.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Types of milking	N = 60		N = 179		N = 30		N = 269	
Hand milking	60	100	179	100	30	100	269	100
Types of hand milking:	N = 58		N = 174		N = 30		N = 262	
Twice suckling & milking	12	20.7	14	8.0	0	-	26	9.9
Once suckling & milking	40	69.0	154	88.5	8	26.7	202	77.1
Both	6	10.3	6	3.4	22	73.3	34	13.0
Types of milk initiation:	N = 60		N = 179		N = 30		N = 269	
Calf suckling	55	91.7	170	95.0	30	100.0	255	94.8
Calf + Feed	2	3.3	2	1.1	0	-	4	1.5
Calf + Salt	3	5.0	7	3.9	0	-	10	3.7
Number of teat suckled:	N = 59		N = 178		N = 30		N = 267	
Two teats	1	1.7	0	-	0	-	1	0.4
Four teats	58	98.3	178	100.0	30	100.0	266	99.6

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

As indicated in table 26, milk initiation practice in cotton based, sesame based farming system and Gendawuha town was more or less comparable. Overall, the highest proportion (94.8%) of the respondents used calf suckling for milk initiation, while few households (5.2%) used in combination of calf suckling and provision of feeds or salt (Table 26). The present finding was in agreement with the report of Gebre-Egziabher *et al.* (2000), who noted that calf suckling results in higher milk yield and long lactation length of the dam as well as higher weaning weight and pre weaning gain of the calf.

As gathered from key informants, households do not practice complete milking during the time following calving and this is meant to benefit the newly born calves get enough milk until the calf commences feeding grass. Thus, milking was performed in three steps depending up on the stage of lactation. According to farmers estimate, during the early stage of lactation following after calving, 25% of the milk was taken until the calf become strong. After the calf become strong, 50% of the milk was withdrawn until the calf start to feed grass. There after, complete milking was done when the calf commenced feeding grass.

4.6.2. Milk equipments

The types of milk vessels used in the three studied locations are presented in table 27. In all inhabitants in cotton based and sesame based farming system and most inhabitants (96.7%) in Gendawuha town used a milking equipment called '*gerera'* (Amharic name) for milking. Overall, 99.0% of the respondents used gerera as a milking equipment, while the remaining (2.2%) of the respondents were using small nickel and plastic materials. *Gerera* is an important milk vessel, which is pot like and made from fruits of the plant called *Lagenaria siceraria* (Qele -in Amharic). When the fruits of the mentioned plant ripe, the out side fruit cover becomes hard and shelly. Then drying the ripe fruits and removing the seeds from inside, gives shelly pot, which is quite hard and strong. It can hold up to 1- 5 liters (Figure 3).

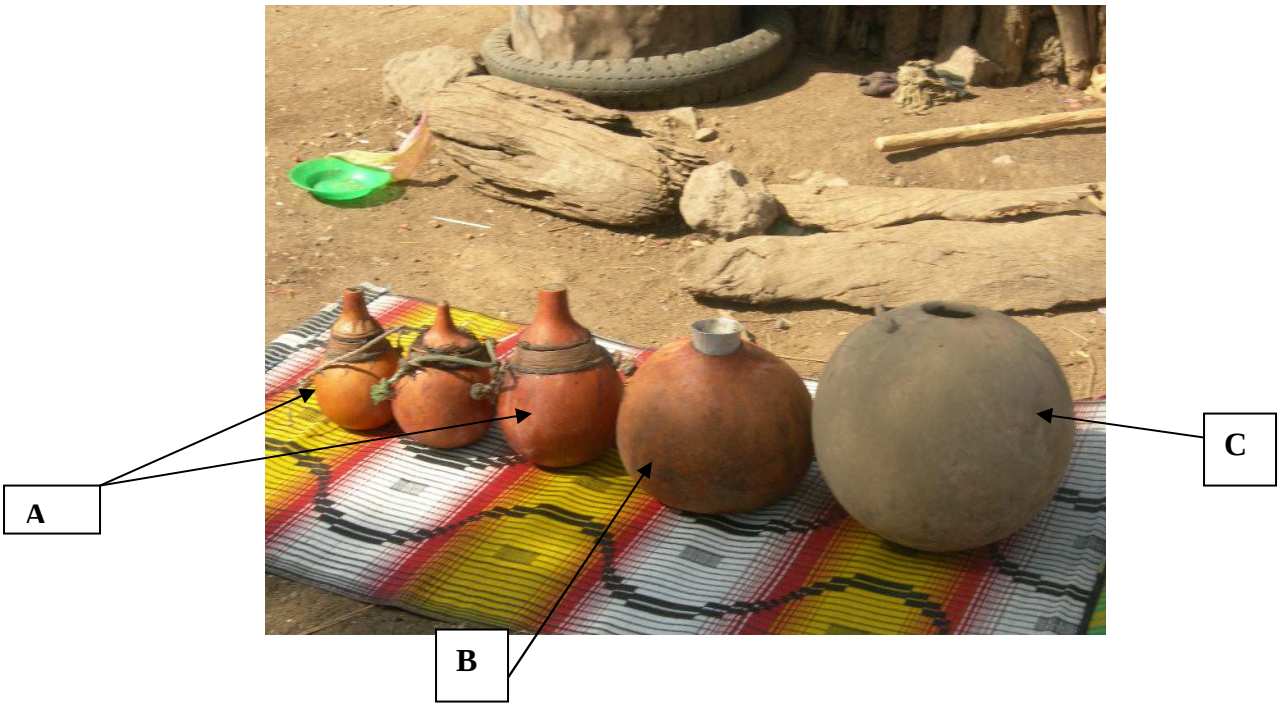


Figure 3: Milk vessels used in Metema district. Three of them, which are indicated in A, are known as “Gerera” in local language and the one indicated by B is known as “Kabbo”, where as the last one, which is indicated by C is known as ‘Gurna”.

Overall, fresh milk was transported from the milking location to the temporary shelter or permanent residence of the farmers with gerera (76.6%) and plastic jerican (35.1%), while few sample farmers used *gurna* (4.3%) and *kabbo* (2.1%) to transport milk (Table 27). In most instances, kabob and *gurna* were used for transportation of milk in sesame based than cotton based farming system. Gurna and kabob are also made from the fruits of *Lagenaria siceraria* plant like that of gerera but they are larger in size than gerera (Figure 3).

Overall, the highest proportions (61.1% and 54.7%) of the sample farmers were using *gurna* and *kabbo* to store milk for fermentation, respectively. Where as, the remaining lower proportion (1.1%) of sample farmers were using plastic jerican containers (Table 27).

Table 26: Milk vessels used in cotton based, sesame based farming system & Gendawuha town.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Milking equipments:	N = 30		N =35		N = 30		N=95	
Gerera	30	100.0	35	100.0	29	96.7	94	99.0
Small nickel container	0	0.0	0	0.0	1	3.3	1	1.1
Plastic container	0	0.0	0	0.0	1	3.3	1	1.1
Milk transport equipment:	N = 30		N = 35		N = 29		N= 94	
Gerera	20	66.7	23	65.7	29	100.0	72	76.6
Plastic Jerican	10	33.3	20	57.1	3	10.3	33	35.1
Kabbo	0	0.0	2	5.7	0	0.0	2	2.1
Gurna	0	0.0	4	11.4	0	0.0	4	4.3
Milk storing equipment:	N = 30		N = 35		N = 30		N=95	
Gurna	10	33.3	20	57.1	28	93.3	58	61.1
Kabbo	28	93.3	20	57.1	4	13.3	52	54.7
Plastic Jerican	0	0.0	1	2.9	0	0.0	1	1.1
Milk churning equipment:	N = 30		N = 35		N = 29		N=94	
Gurna	30	100.0	34	97.1	29	100.0	93	98.9
Gerera	0	0.0	2	5.7	4	13.8	6	6.4
Kabbo	0	0.0	3	8.6	0	0.0	3	3.2
Plastic Jerican	0	0.0	1	2.9	0	0.0	1	1.1

Note that the percentages of the households who are using milk vessels were calculated from the interviewed number of households. * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

As indicated in table 27, the highest proportion (98.9%) of the sample farmers in all categories were using gurna for churning fermented milk, while the remaining lower proportions (6.4%, 3.2% and 1.1%) of sample farmers were using *grera*, *kabbo* and *plastic jerican*, respectively. According to the key informants, in most instances butter was transported to market using *plastic jerican* (containing 5 liters). Glass Jar bottle was used for measuring butter at the

market, considering that one bottle of butter is equivalent to 1 liter, it approximately weighed one kg.

4.6.3. Smoking practices

Nearly all inhabitants in cotton based, sesame based farming system and Gendawuha town areas smoked milk vessels as a traditional preservative method to improve the taste and quality of milk and milk products (Table 28).

Overall, seven different types of plants were used in Metema area for smoking milk vessels, amongst of which three plants were commonly employed for smoking purposes. These include *Terminalia schimperiana* (Abbalo) (98.5%), *Terminalia laxiflora* (Wenbela) (40.2%), Gorgoro (33.2%) and *Dichrostachys cinerea* (Ader) (12.7%) (Table 28). This being the overall situation, choice of smoking plant was considerably different in the three areas. For example, the choice of T. *schimperiana* plant in all the three locations was nearly comparable. On the other hand, in Gendawuha town area, majority of households (75.0%) used *Terminalia laxiflora* (wenbela) than in sesame based (37.9%) and cotton based farming systems (29.6%) (Table 28). In general, the study indicated that households in sesame based farming system area were more versatile in their choice of smoking plant than those in the cotton based farming system and Gendawuha town.

Prior to smoking, the equipments were thoroughly washed using fruits of a plant locally known as "*Lifa*" and were sun dried for about five to ten minutes. According to respondents, milk vessels were smoked for the purpose of getting pleasant flavor and taste of dairy products, extende shelf life of dairy products, bacteriostatic effect, and slow milk fermentation

process. As gathered from key informants, well smoking of milk vesseles will slow down fermentation process and this in return gives higher butter yield as compared to carelessly smoked vessels or unsmoked vessels. However, this needs scientific explanation in the future by conducting a research.

Table 27: Plants used by households for smoking milk vessels in cotton based, sesame based farming system and Gendawuha town.

Variables	**CBFS*		***SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Experience of smoking	N=54		N=178		N=28		N=260	
Yes	54	100.0	177	99.4	28	100.0	259	99.6
No	0	0.0	1	0.6	0	0.0	1	0.4
Types of plant used:	N=4		N= 177		N=28		N=259	
Abbalo	53	98.1	175	98.9	27	96.4	255	98.5
Wonebela	16	29.6	67	37.9	21	75.0	104	40.2
Gorgora	6	11.1	55	31.1	25	89.3	86	33.2
Ader	2	3.7	11	6.2	20	71.4	33	12.7
Kirkera	0	0.0	8	4.5	0	0.0	8	3.1
Akema	0	0.0	1	0.6	0	0.0	1	0.4
Fongera	0	0.0	1	0.6	0	0.0	1	0.4

4.7. Milk and milk products utilization

Household milk off take and its allocation for different purposes is presented in table 29. Other milk derivatives, which are utilized by the household, are presented in table 30. Milk off take by households significantly differed ($P<0.001$) in the three studied areas of Metema district (Appendix table 9). The average amounts of milk produced/day/HH in cotton-based (4.5±0.32 liters) was not significantly different ($P>0.05$) from sesame-based (6.2±0.422 liters) farming

system (Table 29, Appendix table 9). Where as, the average milk volume produced/HH in Gendawuha town (10.0±1.157 liters) was significantly (P<0.05) higher than in the two farming system areas. This may be attributed to higher average holding of milking cows in Gendawuha town than in the two framing system areas. The overall average volume of milk produced/day/HH was 6.3±0.33 liters and ranged from 1 to 32.5 liters (Table 29). Daily milk yield per household (3.0 liters) were reported in East Shoa Zone of Oromia (Lemma *et al.*, 2005), as well as in Shahsemene-Dilla areas (1.97±0.24 liters to 2.84±0.28 liters) (Sintayehu, 2007). On the other hand, higher daily milk yield (25.1 liters) was reported in Awassa (Ike, 2002), but the studied cows were crosses of Holestien Freshian and this may happen the increased milk production of households.

As indicated in table 29, milk utilization pattern of households is similar in the three studied areas. Overall, 63% of the milk produced by the household was reserved for subsequent processing, 18% was consumed with in the household, while 13.2% was given to calves (Table 29). Other than these, minor quantities of fresh whole milk were given to neighbors (4.8%), calf herders (5.4%) or marketed (0.4%).

Table 28: Milk off take and its allocation in the three surveyed areas of Metema district.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
	N=59		N=165		N=30		N=254	
Milk produced in liter/day/HH	4.5[a]	0.32	6.2[a]	0.42	10.1[b]	1.16	6.3	0.33
Milk utilization (%):	N = 58		N=177		N = 29		N=264	
Given to calves	14.7		12.9		10.0		13.2	
Consumed by HH	20.9		17.6		18.9		18.5	
Given to neighbors	2.2		4.7		9.9		4.8	
Given to calf herders	3.7		5.5		7.8		5.4	
Marketed	0.4		0.4		0.5		0.4	
Reserved for processing	64.0		63.0		62.5		63.2	

Average milk produced per household with same superscripts do not significantly differ at 5 % level of significance. * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, SE = Standard error

Fresh milk utilization pattern in Metema area more or less resembled that of observed in highland rural areas of Amhara region, and some rural highland communities in the country, where the preponderance of the daily milk production is processed in to butter and other milk derivatives. For example, a report by Aklilu (2004) indicated that in Amhara region, out of the estimated total amount of 493 million liters of milk produced on a daily basis, 57.5% was processed in to butter and other milk derivatives. Similarly, according to Lemma *et al.* (2005), in East Shoa Zone of Oromia Region, large proportion of the daily milk production (83.3%) was processed and some amount (16.7%) was consumed with in the house. Again the latter study indicated, more or less a similar pattern of utilization as in the presently studied areas, although the proportion retained for further processing is fairly higher than in the presently studied areas.

In Metema area, as in the case of the mentioned rural highlands areas, inhabitants largely depended on crop products as a stable food and do not relay on milk as a major source of food for the household. Therefore, they process it in to butter and sell it. In view of this, although Metema is arid marginal area, it shares more of the highlanders feature than that of lowland marginal areas, where pastoralists largely depend on fresh milk as a sole source of food for their families. For example, a study in Borena area of Ethiopia indicated that 69% of the total milk off take was used for household consumption as fresh and 24% was stored and soured to make butter (Coppock *et al*., 1992).

The present study also indicated that the amount of milk consumed with in the family was considerably higher than even urban and peri-urban areas where farmers have largely crossbred cows that produce fairly high amount of milk compared to the locals in Metema. For example, Negussie (2006) reported that only 4% of the daily produced fresh milk was consumed with in the household in peri-urban/urban areas of Mekele. Also, unlike in Metema, in urban and peri-urban areas, the proportion of fresh milk soured and processed into butter and other milk derivatives is low. For instance in Mekele, only 1% of the daily milk production is processed (Negussie, 2006) and in peri-urban and intra urban areas of Addis Ababa, the proportion processed was 20% and 3%, respectively(Belachew, 1998). In such urban and peri-urban areas, there is relatively adequate market that can absorb the daily milk production in fresh form except during certain occasions when the market cannot absorb the produced milk, in which case farmers are forced to sour the milk and convert it into butter and cheese. Such occasions are for example, extended fasting periods for followers of Orthodox Church during when consumption of animal source food is abstained.

As indicated in table 29, the farmer estimated about 13% of the daily milk production was given to calves and this is what the calves suckle during milking. This indicates that farmers in the studied areas give better management for calves. A similar practice is also exercised in and around Addis Ababa where 12% to 13% of the daily produce was provided for calves (Belachew, 1998), as well as in Mekele where 17% of whole milk obtained daily was used for calf feeding (Negussie, 2006).

As a matter of fact, the market share of fresh whole milk in Metema area was almost negligible (Table 29), not only because of market problem, but also because of cultural restriction against sell of fresh whole milk. Thus, the preponderance proportion of fresh milk is processed or consumed at household level (by family, neighbors, calves) leaving little or no whole milk market. Previous studies conducted in different parts of the country, also indicated the presence of cultural taboo against selling fresh whole milk in different cultures. For example, a study by Lemma *et al. (*2005) indicated that about 96.7% of the respondents in Adami Tulu and Arsi Negelle as well as about 93.3% in Lume districts did not sell fresh milk largely due to cultural taboo and market limitation. On the other hand, cultural restriction against selling whole milk does not exist in urban and peri-urban communities. For example, a report around Mekele indicated that high proportion (78%) of milk obtained was sold in fresh form (Negussie, 2006).

As shown in Table 30, utilization pattern of naturally fermented milk (*Ergo*) fairly similar in the three studied areas. Overall, about 75% of ergo was reserved for butter processing and some 20% was consumed with in the household. Slightly higher proportion of ergo was given

to neighbors in Gendawuha town (10%) than in sesame based (6%) or cotton based areas (4%), where selling ergo was uncommon as in the case of fresh milk (Table 30).

Table 29: Utilization pattern of milk derivatives in different areas of Metema district. The body shows mean percentage (±SE) of the product under the different categories of utilization as rated by respondents using PRA technique.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Fermented milk utilization (%)):	N = 58		N = 176		N = 29		N = 263	
Consumed by HH	21.4	1.51	19.3	1.56	18.8	1.14	19.7	1.11
Given to neighbors	3.9	0.71	6.1	0.45	9.6	0.95	6.0	0.37
Marketed	1.2	0.86	0.4	0.43	-	-	0.5	0.34
Reserved for processing	73.5	1.93	75.4	1.09	71.6	1.68	74.6	0.86
Butter utilization (%):	N = 58		N = 173		N = 29		N = 260	
Consumed by HH	49.5	3.16	59.0	2.22	70.0	2.31	58.1	1.69
Given to neighbors	3.4	0.69	5.3	0.53	10.4	0.84	5.4	0.42
Used for cosmetics	13.5	1.12	10.2	0.53	16.1	1.25	11.6	0.470
Marketed	33.4	3.46	25.4	2.37	3.5	2.09	24.8	1.840

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HH = Household, SE = Standard error.

Fresh milk, fermented milk and major part of the produced butter was consumed with in the household than marketed, although notable difference were observed among the three areas (Table 30). The proportion of butter consumed with in the household was higher in Gendawuha town (70.0%) than in cotton based (49.5%) and sesame based (59.0%) farming system areas (Table 30). On the other hand, the proportion of marketed butter was higher in cotton based (33.4%) and in sesame based (25.4%) farming system areas than in Gendawuha town (3.5%). This is probably due to the fact that most inhabitants in Gendawuha town had

relatively diversified income sources as well as better standard of living than the inhabitants in the two rural areas. Overall, close to two-third of the butter produced in Metema district was consumed with in the family and one-fourth of it was sold out, while the rest was used for cosmetics (11.6%) or given to neighbors (5.4%) (Table 30).

Summary of the utilization pattern of milk and milk products in Metema district is shown as a schematic flow chart displayed by figure 4. The values indicated in the flow chart are proportion (%) of the products under the different utilization categories quantified based on the overall data of inhabitants sampled from the three areas.

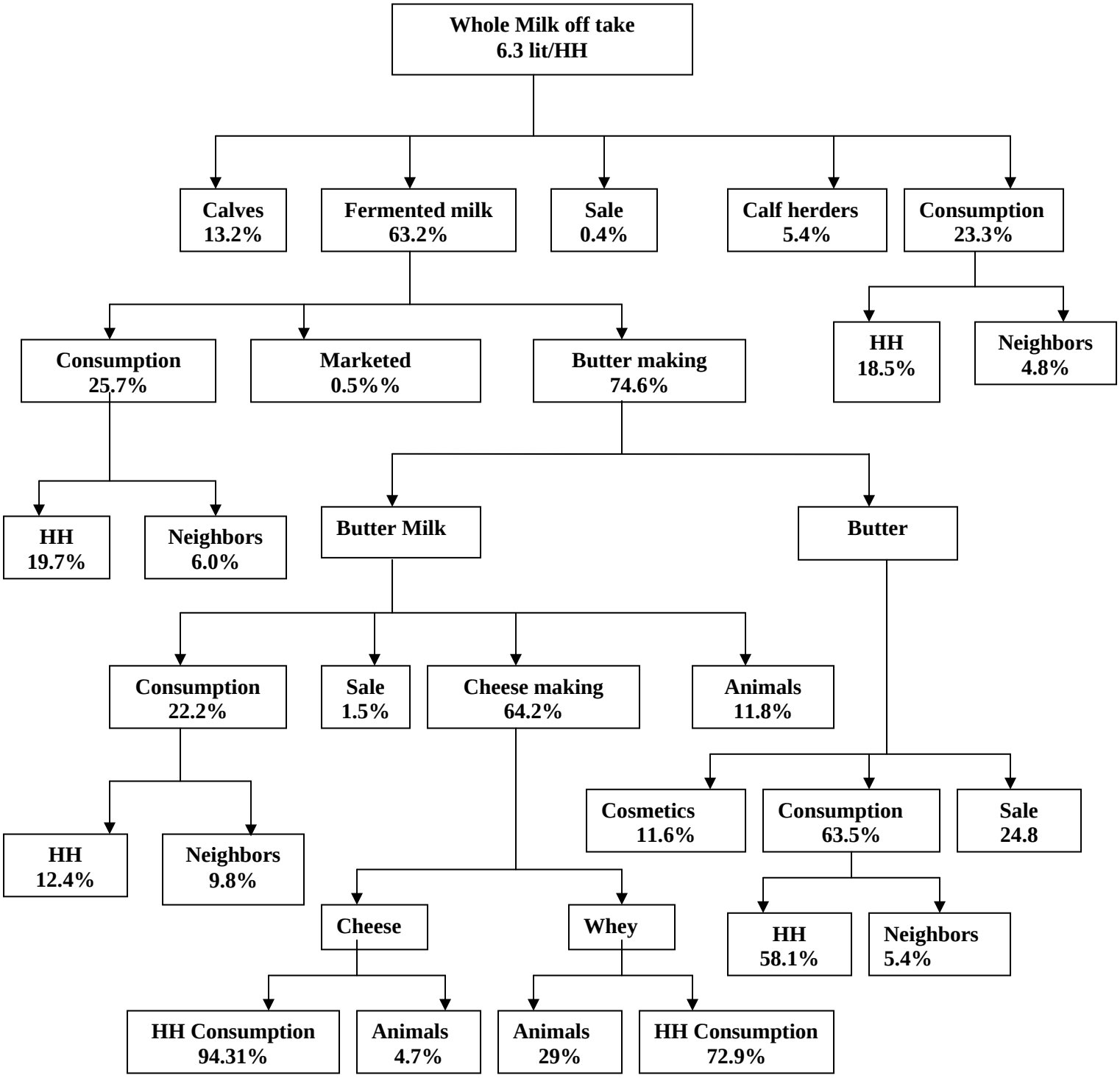


Figure 4: Flow diagram of milk and milk product utilization in Metema district. Note that the values indicated in each box are proportions of the products in the respective utilization category determined based on the overall response of sampled households from the three areas.

4.8. Milk processing practices

Time taken for milk fermentation, butter yield and length of butter storage in different locations is presented in table 31. As in the case of milk processing in different rural areas of Ethiopia, farmers in Metema district fermented fresh whole milk into sour milk prior to churning. During the group discussion, farmers reasoned out why they fermented milk prior to processing it into butter and other milk derivatives. Firstly, they said fermenting milk facilitate butter making process as it is impossible to recover butter if the milk is not soured. Secondly, they said sour milk gives pleasant flavor and good taste for the different milk products and added that the flavor and taste is enjoyable when milk is consumed in the form of Ergo, buttermilk and butter as well. Apart from the taste and flavor, they also considered fermentation is a necessary prerequisite to obtain other milk derivatives like butter milk, cheese and whey. Thirdly, they also pointed out that fermentation increases the shelf life of the processed products like butter and cheese.

In the study area, the average fermentation time of milk was 26.53±1.23 hours in dry season and 34.9±0.82 hours in wet season (Table 31). Higher ambient temperature during the dry season fastens the fermentation process and thus shortens the duration of fermentation time in the dry season.

Before the churning process was started, the fermented milk was shaken and broken down the coagulated milk in order to facilitate easily transfer of milk into the churning pot and ease of churning. As farmers reported, churning methods were different depending on the volume of fermented milk. If the amount of fermented milk was small, churning done on the floor using

pot (placing soft pads or some old clothes under churning pot) and the pot was racked back and forth until butter granules were formed. In addition to this, *gerera* was also used as a pot if the volume of fermented milk is small. Where as, if the fermented milk was large, a larger pot called *gurna* was used as a churning pot. Then a tripod (*Mekahale*- in Amharic) was made and the pot was hanged with rope on the tripod and swung back and forth until butter granules were formed. As an alternative, a doorpost was used to hang the churning pot (Figure 5).

Table 30: Milk fermentation and butter storage time in Metema district

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Milk fermentation time:	N = 59		N=177		N = 30		N=266	
Dry season(hours)	31.9	3.820	30.1	1.499	18.3	0.718	26.5	1.234
Wet season(hours)	31.4	1.383	37.0	1.096	29.5	1.105	34.9	0.820
Butter storage:	N = 54		N=121		N = 5		N=180	
Length of storage(months)	7.0	0.598	5.6	0.237	9.0	0.632	6.1	0.246
Volume of milk to produce 1kg of butter:	N = 51		N=159		N = 30		N=240	
Dry season(liters)	23.1	0.938	13.2	0.496	19.0	1.035	17.7	0.668
Wet season(liters)	22.7	0.794	19.5	0.468	20.6	0.545	20.3	0.368

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count, SE = Standard error

Figure 5: One of the churning methods used in Metema district by hanging the churning pot with the doorpost by one of the female children in the household

While churning, the gas formed in the pot was released from time to time by removing a small wooden plug, which is found at the center of the lid or side way of the churner for few minutes until the pressure inside the pot was totally withdraw. Also, the wooden plug was pulled out to release a few drops of milk and to check whether butter granules have formed or not. Accordingly, the drop was rubbed in between the thumbs and pointing finger and inspected if fats granules have appeared or not. Thus, up on noting fat granules some amount of water (up to half a liter) was added into the churning pot to float the butter granules and the churn was swayed on its base to float the fat granules and form lumps of butter. Then, the butter was skimmed off, kneaded in cold water and washed to remove residual buttermilk.

As indicated in table 31, based on data collected from farmers, the amount of milk required to produce one kg of butter was 17.7±0.66 liters in dry season and 20.3±0.36 liters in wet season. As indicated in the methodology section, empirical record was taken from 15 selected

households regarding the volume of milk churned at a time and amount of butter produced during the wet season. Based on the empirical recorded data the average volume of milk needed to produce one kg of butter was estimated as 17.6±0.10 liters. Since this estimate corresponded to wet season, the value was compared with the wet season estimate of farmers and the difference was 2.7 liters. This shows that the average estimate derived from the survey data did not seriously deviate from the estimate obtained from empirically recorded data. Thus, the survey data can be considered as a reasonable approximation and fairly dependable result. As noted Zelalem and Inger (2000), in the central high lands of Ethiopia, 21-25 kg of milk was required to produce 1kg of butter and this value was fairly large compared to the estimate obtained in the present study.

Churning was usually preferred early in the morning when the temperature was cool. Farmers reasoned out that high ambient temperature melts the butter and lowers the amount of butter recovered after churning. From the overall data, most of the sample farmers (83.33% and 59.54%) churned their fermented milk every 24 hours interval in dry and wet season, respectively (Table 32). The farmers reported that high ambient temperature and fermented milk volume were factors to decide on how often to churn.

Table 31: Churning frequency of milk during dry and wet seasons in Metema district.

Variables	*[*]CBFS*		*[**]SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Churning frequency in dry season:	N = 13		N=35		N = 30		N=78	
Twice in a week	1	7.7	0	0.0	0	0.0	1	1.3
Every 24 hours	3	23.1	32	91.4	30	100.0	65	83.3
Every 12 hours	0	0.0	1	2.9	0	0.0	1	1.3
After 3 days	9	69.2	1	2.9	0	0.0	10	12.8
After 2 days	0	0.0	1	2.9	0	0.0	1	1.3
Churning frequency in wet season:	N = 56		N=176		N = 30		N=262	
Once in a week	0	0.0	1	0.56	0	-	1	0.38
Every 24 hours	51	91.1	75	42.61	30	100.0	156	59.54
Every 12 hours	2	3.6	0	-	0	-	2	0.76
After 3 days	2	3.6	50	28.40	0	-	52	19.84
After 2 days	1	1.8	50	28.40	0	-	51	19.46

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

In the studied areas, farmers customarily melted and seasoning it with spices that they use for household consumption and stored. Other wise, if the butter is to be sold, it is stored in the form of ghee. During ghee making, the butter was melted in a nickel pan ("Biret Dist", Amharic name) and heated on open fire. Different spices were added while the melting progressed and in most instances these included Trigonella *foenum-graecum*, *Allium sateivum*, *Zingiber officinale*, *Rumex abyssinicus*, *Aframomum corrorima*, and *Allium cepa*. The spices were added to improve the taste, color, smell and shelf life of the finally recoverable ghee. The melting process continued until the moisture in the butter was completely evaporated out, which was marked by the disappearance of foaming bubble and appearance of yellowish butter oil. Then the pot was taken off and cooled down for some 10 to 15 minutes to allow unwanted

solid residue settle down after which time the supernatant was decanted and transferred into a different containers. As indicated in table 31, butter produced in such a way was stored for an average period of 6.1±0.24 months and ranged between 2 and 18 months. As gathered during the survey, farmers store butter for different reasons, majority (49%) said they stored it searching for better price, while 35% said for the sake of reserving it for later use especially during the dry season when milk production and thus butter yield decreases. Still some 16% said they stored ghee as a liability to sell it when they face problem.

4.9. Cattle fattening practices in Metema

The experience of fattening and the reasons for not having fattening practice in Metema district are presented in table 33. Cattle fattening practices in cotton based, sesame based farming system and Gendawuha town were more or less comparable. Out of the total number of interviewed farmers (N = 265), only 1.1% were involved in cattle fattening, while the rest (98.9%) had no experience of fattening cattle (Table 33). According to farmers, different factors accounted to the low level of involvement in fattening activities. Inhabitants in cotton-based areas attributed this to lack of experience (23.5%), lack of labor (34.1%), feed shortage (17.6%) and money shortage (24.7%), while in sesame based farming system, these four constraints accounted to 40.8%, 26.5%, 16.8% and 14.8%, respectively. Where as in Gendawuha town, the first three factors were mentioned as problems (29.4%, 47.1% and 20.6%, respectively) and shortage of money was not considered as a constraint (Table 33).

As indicated in table 33, when cattle became out of production and culled, most farmers in all the three areas sold them directly with out improving their body condition, although

proportionately more inhabitants in cotton based (38.3%) conditioned culled cattle before selling them in sesame based areas (17.9%) and Gendawuha town (3%). One peculiar feature noted in Gendawuha town was that some households (12.1%) slaughter culled cattle and share the meat among neighbors. Although this practice exists in rural communities, it is less frequent and done during special occasions such as during religious or cultural festivals. Overall, proportionately more inhabitants (77.6%) in Metema district sell their cattle immediately when they got out of production if there is market access. Where as, lower proportion of households (20.6%) provided better feeding for some days to improve their body condition before selling. The present result was in agreement with the report of Tesfaye *et al.* (2005) at Bako Agricultural Research Center, who noted that culled cattle are usually sold for slaughter with out improving their body condition when they are too old for ploughing or poor in milk production or when cash shortage forces farmers to sell their animals with out any further finishing.

During the group discussion, it was pointed out that farmers in the study area had an experience of purchasing emaciated oxen at times when the price of cattle become cheaper in their locality or near by high land area. Then, these cattle were separately tended from other age group of cattle and grazed at places, where the natural herbage is ample and lush for a period of time ranging between 15 to 30 days. Farmers said, the body condition of the oxen usually improved fairly good to fetch attractive prices with only provision of better grazing for such a short period of times. This experience was quite a recent venture started following the increased demand for Ethiopian cattle in the Sudan livestock market. As gathered from the key informants, in most instances, farmers in the area purchased relatively young and uncastrated

oxen for marketing purposes, this is because uncastrated and relatively young oxen showed improvement with in short period than others.

Table 32: The experience of fattening and reasons for not practicing fattening in cotton based, sesame based farming system and Gendawuha town.

Variables	**CBFS* %	***SBFS* %	*Gendawuha* %	*Overall* %
Experience of fattening:	N = 60	N=175	N=30	N=265
No	98.3	96.7	96.7	98.9
Yes	1.7	0.6	3.3	1.1
Handling of culled cattle:	N = 60	N=178	N=29	N=267
Sell immediately	61.7	81.6	84.8	77.6
Sell after body condition improved	38.3	17.9	3.0	20.6
Slaughter & share with neighbors	0.0	0.6	12.1	1.8
Reasons for not practiced fattening:	N = 50	N=144	N=29	N=223
Lack of experience	23.5	40.8	29.4	34.9
Lack of labor	34.1	26.5	47.1	30.8
Feed shortage	17.6	16.8	20.6	17.5
Shortage of money	24.7	14.8	0.0	15.9
Shortage of water	0.0	0.5	0.0	0.3
No interests for fattening	0.0	0.5	0.0	0.3
Theft problem	0.0	0.0	2.9	0.3
Access for extension service:	N = 60	N=170	N=30	N=260
Yes	3.3	0.6	0.0	1.2
No	96.7	99.4	100	98.8

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

As shown in table 33, with the exception of some households (1.2%), almost all sample farmers in the study area had no extension support regarding better skills of fattening, credit or

any inputs provision. In general, extension service given for the farmers regarding cattle fattening venture by governmental and non-governmental organization was at its rudimentary stage and nominal until now. However, currently with the technical assistance of IPMS Ethiopia project, MOA has started to provide some viable extension activities, since the starting fattening extension service by the beginning of 2007. Pioneer farmers were trained and closely supervised by expertise. Their practice of fattening was forage based fattening and supplemented with crop residues, noug and sesame cakes and cotton seed cakes.

As observed in the study area, cattle fattening has good opportunity for future expansion. Firstly, the district has extensive and large size communal grazing lands that are highly productive and good sources of green pasture as well as sources of conserved forage (hay). Secondly, oil seeds (sesame) are cultivated extensively and cakes produced as a by products of local extraction as well as from near by industries found in the town were used as a good sources of supplementation for the fattened cattle. Particularly, there is ample source of sesame cakes (*Embaze*), which is a by-product of local oil extraction processes (*Ansara*- Amharic name). As gathered from the key informants, locally produced sesame cake was better feeding value than other cakes produced from modern industries, since the local processing tools and machineries are not as efficient as the modern machines in extracting the oil from the seeds. As a result, availability of oil seed cakes can be considered as a good prospect to promote fattening in the district, because the cakes have high crude protein, which is usually deficient in natural pastures and together with the ample grazing can provide a good source of feed for fattening. Thirdly, there is a high cattle source in the district and good cattle market just across the border in Sudan that can absorb large supply of fattened cattle. As observed during the

fieldwork, farmers have recently started to exploit this market in that the farmers in the area after they finished with ploughing around August, they improve the body condition of oxen and provided for sale. Thus, such initiation from farmers can be considered as a prospect for using the existing high potential of beef production in the district.

Despite all these prospects to improve beef cattle production in Metema district, cattle fattening is at its rudimentary stage at present owing to a number of problems, which could be solved if farmers are given the necessary technical support through adequate extension service. As discussed earlier, the area is stricken with feed and water shortage during dry season and lack experience in cattle fattening (Table 33) as well as disease problem (Table 21). As a matter of fact, these problems are rather apparent than real constraints because the resource base is available to solve these problems and it only requires to give them adequate attention and work on them. For example, dry season feed shortage constrained productivity because farmers in the district do not practice fattening in part because of knowledge gap as well as necessary technical support. Again, diseases and dry season water shortage are apparent problems, which require due technical support.

As a result, realization of the existing potential and improving the farmers life lies with provision of adequate extension service. In fact, the existing live animal market (particularly cattle) is largely based on smuggling across the border to Sudan. Nonetheless, if cattle fattening can be improved and the market can be made formal, the country can benefit from its livestock resource considerably, apart from improving the livelihood of farmers even to an extent far better than “simply food self sufficient”.

4.10. Meat consumption

Meat consumption behavior in cotton based, sesame based farming systems and Gendawuha town was comparable. Almost all sampled farmers (99.6%) had the experience of consuming meat (Table 34) and this indicated the presence of no taboo in the culture of the inhabitants against consumption of meat except during Ethiopian Orthodox Christianity fasting period.

Inhabitants in the two rural communities largely consumed meat during holidays or occasionally during the regular non-holiday days and that consume meat as regular diet during non-holiday times were proportionately less (Table 34). By contrast, in Gendawuha town, households that consume meat during the holiday times (34.1%), where as those that consume meat during other ordinary time (34.1%) or occasional consumers (31.8%). This is largely a reflection of the standard of living of the residents in the town compared to those in rural communities. Even though the proportions were relatively lower, compared to rural communities else where in the country, it can be said that the proportion of households in rural areas of Metema that frequent meat diets during ordinary non holiday times was still high. This may indicate the fact that the standard of living of rural households in Metema is relatively better compared to several farming communities particularly in the high land of Ethiopia.

As reported by farmers, cattle were frequently slaughtered between the months of December through January and in April for occasion like weedding, which is frequently arranged during these months. Also, religious holidays like Christmas and Epiphany take place during these months and it is customary to slaughter cattle during these times. On the other hand, other

species like goats and sheep could be slaughtered during other major holidays such as New Year (in September) and Easter (in April). Also, capable farmers slaughter cattle and share the meat during the wet season when the animals are in good body condition.

Table 33: Sources of meat for consumption and time of meat consumption in Metema district.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Experience of meat consumption:	N=60		N=180		N=30		N=270	
Yes	60	100	179	99.4	30	100	269	99.6
No	0	0.0	1	0.6	0	0.0	1	0.4
Time of meat consumption:	N=60		N=178		N=30		N=268	
Holydays only		41.5		41.2		34.1		40.3
Frequently during ordinary days		17.6		23.9		34.1		23.9
Occasionally during ordinary days		40.8		34.8		31.8		35.7
Sources meat for consumption:	N=58		N=179		N=30		N=267	
Sharing meat with others		63.6		52.5		33.3		43.2
Slaughtering individually		36.4		40.9		33.3		44.9
Purchased from butchers		0.0		6.6		33.3		11.9
Species used for sharing meat:	N=24		N=154		N=30		N= 08	
Cattle		91.7		95.0		93.8		94.3
Goats		8.3		4.4		6.3		5.3
Sheep		0.0		0.6		0.0		0.4
Sharing meat:	N=33		N=142				N=175	
Frequency of slaughtering cattle in groups/year	6.9	0.84	6.0	0.48	-	-	6.2	0.42
Participants at a time	32	2.17	30	1.08	-	-	31	0.97

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

As in the case of most areas in the country, inhabitants of Metema obtained meat from three sources, i.e., slaughtering animals in groups and share the meat or slaughtering animals individually (commonly small ruminants) or meat purchased from butchers (Table 34). In the two studied rural communities, the first two sources were used as the sole sources, as butcheries were uncommon in rural areas, which is often the case in most rural areas in the country. Unlike the rural areas, in Gendawuha town, all the three sources were equally important as source of meat for the family (Table 34). Overall, inhabitants in Metema district obtained meat for the family either by slaughtering cattle in groups and sharing the meat (43.2%) and/or by slaughtering small ruminants individually (44.9%), while the rest one-tenth purchased meat from butcheries. Unlike in most metropolitan areas where municipalities forbid slaughter of cattle in the neighborhood, there was no restriction of this sort in Gendawuha town. The cost of shared beef only accounts the purchase cost of cattle and there is no even additional labor cost as the sharing process is entirely handled by group members. As a result, the cost of group shared beef is far cheaper than beef purchased from butcheries and this together with lack of restricting slaughter place may have contributed to the low significance of butcheries as a meat source in Gendawuha town, unlike most towns and cities in the country, where butcheries are the major source of beef for household consumption.

As indicated in table 34, cattle were the most frequently slaughtered animals for group share (94.5%), while small ruminants were rarely shared among groups of individuals (5.7%). This is perhaps households could afford to slaughter small ruminants individually. As farmers reported in table 34, inhabitants in Metema district participated in-group sharing of meat with neighbors or related families on average 6.2±0.421 times per year and the average number of

participants in the group-share at a time was 31±0.9 households (Table 34) and these were fairly comparable in the two rural communities.

4.11. Meat utilization and processing

Meat utilization and processing practices in the study area are presented in table 35. Overall, half of the total fresh meat produced by the inhabitants in Metema district was utilized as fresh (49.8%) and the rest half was retained for further processing (50.2%) (Table 35), but this varied from place to place. In the two rural communities, slightly more than half (52.9-56.9%) of the produced meat was consumed in fresh form, where as the rest (43.1- 47.1%) was reserved for processing prior to consumption in which the processing involved largely drying the meat in various ways. By contrast, in Gendawuha town, inhabitants processed most of their meat (90.1%) prior to consumption, while only one-tenth of the meat was prepared for consumption in fresh form (Table 35). On the contrary, Tesfaye *et al*. (2006) reported that the proportion of meat preserved in East Shoa zone was 94.7%.

As indicated in table 35, meat processing was a customary practice and most households (96.2%) had meat processing experience, except for few households (3.8%), who did not involve in this activity because of shortage of meat for processing. Air-drying was the most common method of persevering surplus meat and all households in the two rural areas, and most in Gendawuha town applied this method to preserve excess meat. Even some 20% used smokes together with air-drying. As gathered from farmers, surplus meat should be immediately processed and preserved to arrest microbial spoilage or other wise the meat develops molds and produced bad smell due to high ambient temperature in the area.

Fresh meat variously seasoned and air-dried gives a product locally known as '*quanta*', which is a tradition of most cultures and practicable in most rural and urban communities in Ethiopia. Preserving fresh meat in the form of *quanta* is common, although some other methods are practiced in some places such as Tesfaye *et al*. (2006) noted in east Showa zone, where inhabitants ground the meat and preserved it, as a traditional method of processing.

As reported by the farmers, during quanta preparation, first the meat was sliced in to long strips and was seasoned using salt, oil and pepper powder (Table 35). Households in cotton-based areas used salt alone (82.4%) or oil (17.6%) and it was uncommon to use powdered pepper to season the sliced meat. Similarly, in sesame based, the first two items were used as a seasoning substance, although the proportions who used salt alone (58.1%) or oil (40.9%) differed from those in cotton based. In Gendawuha town usage of powdered pepper was also common, in addition to salt and oil (Table 35). Yet there were few (4.2%) households in Gendawuha town, who were not seasoning the meat at all. As gathered from farmers, the purpose of seasoning the meat with these substances was to repel flies away. After seasoning, the strip of meat was hanged on a rope or thin stick of bamboo fixed in the house under a shade. Unlike this, Ahmed *et al.* (2003) noted that camel meat was hanged in open and dried direct sun in Afder zone of Somalia.

After ensuring complete drying, which usually took some 3 to 5 days, the resulted strips of *quanta* packed in bags and utilized in different forms. In most instances, the processed meat (*Quanta*) was cut into pieces and cooked as stew, which is Ethiopian traditional dish famously known as "*Quanta wot*". Some times *Quanta* was consumed directly or after roasting it on

open fire. As gathered from key informants, *Quanta* was not stored for extended period of time and consumed after preparation and this was because of the small quantity of meat processed into *quanta*. Due to this reason, the amount of meat purchased or sharing meat with the neighbors was not too much.

Table 34: Meat processing practice and utilization in Metema district.

Variables	**CBFS*		***SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Meat processing:	N=58		N=176		N= 0		N=264	
Yes	55	94.8	169	96.0	30	100	254	96.2
No	3	5.2	7	4.0	0	0.0	10	3.8
Types of processed meat:	N=55		N=171		N=30		N=256	
Air dried	55	100	171	100	24	80.0	250	97.7
Smoked + Air dried	0	0.0	0.0		6	20.0	6	2.3
Added Items in processing:	N=28		N=59		N=28		N=15	
Salt		82.4		58.1		33.3		53.3
Oil		17.6		40.9		33.3		34.2
Pepper powder		0.0		1.1		29.2		11.1
Nothing added		0.0		0.0		4.2		1.5
Meat utilization (%):	N=33	Mean(SE)	N=155	Mean(SE)	N=30	Mean(SE)	N=218	Mean(SE)
Consumed as fresh		52.9(4.35)		56.9(1.77)		9.9(1.63)		49.8(1.79)
Reserved for processing		47.1(4.35)		43.1(1.77)		90.1(1.63)		50.2(1.80)

As mentioned earlier, people in Metema area process fresh meat in the form of *quanta* when there was surplus meat in excess of consumption. However, in some places *quanta* has been used as a means of preserving excess meat when people are forced to slaughter their animals up on anticipating drought and disease mishaps. For example, according to Ahmed *et al.*

(2003), inhabitants in Afder zone area slaughtered their camel and process the meat in to *quanta* during when they face drought and disease out break. Mostly they kill weaker and most affected animals before they die and use *quanta* making as a means of crises management. In the old days, people commonly used to carry *quanta* as a dry ration when traveling to distant locations for various reasons.

4.12. Milk and milk products marketing

The experience of milk and milk product selling in Metema district is presented in table 36. Proportionately more inhabitants (71.7%) in cotton based farming system areas were involved in selling dairy products than inhabitants in sesame based farming system (49.7%) and Gendawuha town (16.7%) areas. This may indicate that the need for immediate cash sources was higher in cotton based and sesame based farming system than in Gendawuha town. This is because inhabitants had more diversified income sources in Gendawuha, followed by sesame based farming system than in cotton based farming system area. As a result, inhabitants in cotton-based areas are compelled to sell dairy products as a means of cash source for immediate needs. Overall, nearly half of the households in Metema district were involved in marketing dairy products and the rest half used the produced dairy products with in the family (Table 36).

Among households that were involved in selling dairy products, in the two rural areas, over 90% sold butter while insignificant proportion of the households were involved in selling other dairy products (Table 36). Where as, in Gendawuha town butter milk was equally important marketable dairy product sold by 60% of households as butter (60%). In general, unlike many areas in the country, household was not observed in selling traditional cottage cheese (Ayib) in

all the surveyed areas rather it was consumed by the family and given to animals (calves and pet animals) together with the whey (*Aguat*).

Table 35: Salable dairy products in cotton based, sesame based farming system and Gendawuha town.

Variables	*CBFS		**SBFS		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Selling dairy products	N = 60		N = 179		N= 30		N = 269	
Yes	43	71.7	89	49.7	5	16.7	137	50.9
No	17	28.3	90	50.3	25	83.3	132	49.1
Salable dairy products:	N = 43		N = 89		N =5		N = 137	
Raw milk	1	2.3	1	1.1	1	20.0	3	2.2
Fermented milk(Ergo)	2	4.7	0.0	0.0	0	0.0	2	1.5
Butter milk	0	0.0	2	2.2	3	60.0	5	3.6
Butter	43	100	88	98.9	3	60.0	134	97.8

Note that the percentage was calculated from the respondents indicated. * CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count.

4.12.1. Whole milk market

As indicated in table 36, proportionately very few inhabitants (2.2%) in Metema district brought whole milk to the market for sale. Attributing to the reasons why it was uncommon to sell whole milk, majority of the households said shortage of milk (49.8%), as the main reason, while some said lack of access to market (21.2), cultural restriction (20.8%) and the desire to convert whole milk into other dairy products (8.2%) as the reasons for not selling whole milk (Appendix table 10). Considering the farming system, the extent of cultural inhibition of selling whole milk in the case of Gendawuha town and sesame based farming system areas were lower than that of cotton based farming system area. This is probably due to Gendawuha town and most sesame based farming system areas were located along the main and sub roads

of the district where there is better access to sell whole milk. Earlier studies in Amhara region indicated that out of the total amount of whole milk produced, lower proportion (0.75%) was allocated for sale (Aklilu, 2004). CSA (2003) also reported that only 5% of the total national production of milk in a given year was marketed as fresh whole milk.

During group discussion at each farming system, it was explained that selling of whole milk is considered as an indication of maximum poverty. Due to this reason, even though some producers had intention to sell whole milk, they were often discouraged because of the bad image it may inflict them in the community. This attitude of the society shall be changed through provision of appropriate and continuous educational training.

On the other hand, transhumant (highlanders), who came to the district during rainy season had no problem of selling whole milk, and often provided milk to customers through delivery system. Thus, inhabitants in rural and small towns, who had no milking cows, purchased whole milk for consumption as well as for the production of other dairy products. Specially, teahouses and hotels in the main town (Gendawuha) and small towns were the main customers of the transhumants for whole milk.

4.12.2. Butter milk (*Wegemit*) market

As indicated in table 36, buttermilk was one of the marketable products sold by majority of households in Gendawuha town (60%) than in the two rural communities. The urban nature of Gendawuha town may have created good market option for buttermilk. Nonetheless, looking at the over all picture in Metema only few proportions of households (3.6%) considered buttermilk as a marketable dairy commodity.

As gathered from key informants, buttermilk was largely sold between September and December. During this time, the milk production starts to decline and people who had no cows for milking purchased buttermilk from the producers. Some farmers also believed that consumption of buttermilk during the rainy season could causes health problem by predisposing the person to malaria infection, swelling of pancreas and bulged stomach. As a result, buttermilk was mostly given to calves and pet animals during the rainy season. This idea created by the farmers needs further scientific explanation.

4.12.3. Butter market

As discussed earlier, butter was the most marketable dairy product in Metema district and over 90% of the producers in the district generally sold their butter. In Gendawuha town, less proportion of households had involved in butter selling business than in the two studied rural communities because the town residents could afford to consume it with in the household than using it as a cash source, as they were better off than the rural farmers. As indicated earlier, out of the total amount of butter produced by the producers in the studied areas, only 24.8% was marketed (Table 30). Research conducted in Amhara region (Aklilu, 2004) revealed that out of the total amount (16,685,400 tones) of butter produced per year, 37.92% was marketed, a proportion which is slightly higher than that of found in the present study.

4.12.3.1. Butter sales outlet

Butter sale outlets by the producers in wet and dry season are presented in table 37. During the wet season, most inhabitants in cotton based (88.9%) and sesame based farming system (87.5%) areas sold their butter at market places, where as inhabitants in Gendawuha town either sold their butter at farm gate (50.0%) or delivered to market (50%). During this time of

the year, considerably higher proportion of households in Gendawuha town could use farm gate as a sales out let because the houses are more densely situated and easily reachable than the widely scattered houses in rural areas which pose problems for customers to locate and buy butter at the farm gate. Due to this, farmers in rural communities preferred to bring their butter to market places. The significance of market place as a butter sales outlet increases during the dry season than in the wet season. As shown in table 37, 96.4% of the households in cotton based and 90% in sesame based areas sold their butter at market places. In Gendawuha town, although the majority (66.7%) sold butter at market place, still one third used farm gate as optional outlet. In addition, most households in cotton based (85.4%) and sesame based farming systems (76.2%) said they preferred to sell their butter at market places. Since it gives them the opportunity to select among the many potential buyers and thus fetch good price. On the other hand, all households in Gendawuha town preferred market place as sales outlet to get reliable customers (Appendix table 11). Although relatively few, some inhabitants in sesame based farming system used delivery system as a sales outlet and directly delivered butter to consumers, teahouse and hotels, which was rather uncustomary practice in cotton-based areas or Gendawuha town. In general, during the wet season 87.4% of the sales outlet was market place, 8.4% was farm gate and the rest 4.2% was delivery system. Where as, in dry season, these three options accounted to 91.2%, 4.4%, and 4.4%, respectively of the sales out let for butter selling (Table 37).

As gathered from producers and other marketing agents, the dairy marketing system identified in the studied areas was entirely informal marketing system. This means that the producers sold dairy products directly to consumers and/or traders with out any intervention of the

government. The price of dairy commodities was set through negotiation between the producers (sellers) and potential buyers such as consumers and traders. As a matter of fact, marketing systems of dairy and other livestock products is largely informal in several different places in Ethiopia, such as reported for Mekele area where the dairy marketing system was informal (Nigussie, 2006). By contrast, the marketing system of dairy and some livestock products can be formal in and around some large metropolitan cities, such as Sintayehu (1993) noted the existence of a formal dairy marketing system in Addis Ababa milk shed.

Table 36: Butter sales out let during wet and dry seasons in cotton based, sesame based farming system and Gendawuha town.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	HHC	%	HHC	%	HHC	%	HHC	%
Wet season:	N=42		N=67		N=1		N=110	
Farm gate		11.1		5.6		100		8.4
Market place		88.9		87.5		0.0		87.4
Delivery to customers		0.0		6.9		0.0		4.2
Dry season:	N=27		N=55		N=3		N=85	
Farm gate		3.6		3.3		33.3		4.4
Market place		96.4		90.0		66.7		91.2
Delivery to customers		0.0		6.7		0.0		4.4

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

As reported by key informants, unless there was a constraint of money, farmers mostly stored butter for a certain period of time until considerable volume of butter was stored and the price elevated. Of course, butter was sold if there was a surplus left from household consumption.

Types of butter buyers

As a while, traders were the most important buyers of butter from market places during both wet and dry seasons followed by urban consumers, where as tea houses and hotels as well as rural consumers had insignificant contribution as a potential buyer of butter from market place out let (Table 38). However, variations were noted in the type of buyer from place to place depending on the season. For example, during wet season, traders rather than urban consumer were more important as buyers of butter from market places in cotton based areas (64.4% and 35.6%, respectively). Where as, both types of customers were equally important in sesame based areas (each contributing 49.2% of the purchase) as well as in Gendawuha town, where urban consumers accounted to 100% of the transaction (Table 38). During the dry season, traders accounted to most or all of the purchased butter from market places of cotton based areas (96.3%) and Gendawuha town (100%). By contrast, in sesame-based areas, urban consumers also accounted a fair bit transaction (28.8%), although still traders made up the bulk of the purchased butter (66.1%) from market places during dry season (Table 38). Over all, producers preferred selling butter to traders than to urban consumers during dry than during wet season.

As shown in table 38, the proportion of households who sold butter to traders and urban consumers during dry season was 75.9% and 19.5%, respectively, where as during wet season, the ratio was 65.7% to 33.3%. As might be expected, butter production increases during wet season and following this the price become cheaper in wet season than in dry season. As gathered from farmers, when price become cheaper during wet season the participation of urban consumers in butter transaction increases as the prices are affordable. Where as, during

the dry season , when butter supply becomes in short and prices elevated, less urban consumers afforded to use butter and hence their participation in the market accordingly reduces, but traders kept on purchasing butter even with higher prices to sell to the capable consumers and hence most households sold butter to traders. In general, the bulk of butter was sold to traders than to other clients during both seasons, although their significance increased in dry season because of the reduced capacity of urban consumers as potential butter users. As opposed to the present observations, consumers accounted to a large share (75%) of milk purchased from producers than traders in Addis Ababa milk shed (Sentayehu, 2003). Similarly, Staal and Shapiro (1999) reported that higher proportion (90%) of marketed milk in sub-Sahara Africa was provided informally to customers than traders, which is contrasting observation to the findings of the present study.

Table 37: Types of butter buyers at market place sales outlet in wet and dry season in cotton based, sesame based farming system and Gendawuha town.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	HHC	%	HHC	%	HHC	%	HHC	%
Wet season:	N=40		N = 63		N = 1		N =104	
Urban consumers		35.6		49.2		100.0		33.3
Traders		64.4		49.2		0.0		65.7
Tea house and Hotel		0.0		1.5		0.0		0.9
Dry season:	N = 27		N = 54		N = 1		N =82	
Urban consumers		0.0		28.8		0.0		19.5
Traders		96.3		66.1		100		75.9
Tea house and Hotel		3.7		3.4		0.0		3.4
Rural consumers		0.0		1.7		0.0		1.1

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Mode of payment and determinants of butter prices

Cash was the common mode of payment for butter transaction in all the three locations during both dry and wet seasons, respective of the type of sales out let used (Appendix table 13).

As shown in table 39, producers butter price was some how influenced by sales outlet, season of the year and location. Overall, information collected from the total number of sample producers (N=208) indicated that the overall average butter prices ranged from ETB 22.5 to 25.0/liter in wet season, while ETB 24.0 to 27.0/liter in dry season depending up on the sales out let (Table 39). Thus, butter price was higher during dry season than during the wet season, in particular market places than in other sales out let, ie, the market price of butter increased on average by 3 ETB during the dry season compared to the wet season price in the two rural areas, where as the increment at Gendawuha town was 5 ETB.

Hence, season is one of the factors, which determined the price of butter in Metema district. As gathered from farmers, during the dry season little or no milk was produced from cows because of shortage of feed resources and higher ambient temperature. As a result, little quantity of butter was produced during the dry season and much of the butter utilized or available in market was what the producers stored from their wet season production. Due to this reason, the price of butter elevated during the dry season. In addition to the increased butter production during the wet season, transhumant (highlanders) also contributed to the supply of butter during wet season in Metema district. Hence, butter supply in every sale out let was higher during the wet season and this obviously cheapened the price during the main rainy season and to some extent during the early part of dry season.

Table 38: Butter price at different sales outlet during wet and dry season in cotton based, sesame based farming system and Gendawuha town.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)	N	Mean(SE)
Wet season:								
Farm gate	5	22.4(1.208)	4	22.0(0.408)	1	25.0	10	22.5(0.654)
Delivery system		-	5	25.0(0.837)		-	5	25.0(0.837)
Market	40	24.2(0.423)	62	24.0(0.240)	1	25.0	103	24.1(0.218)
Dry season:								
Farm gate	1	24.0	2	21.0(1.000)	1	30.0	4	24.0(2.160)
Delivery system		-	4	25.0(0.707)	1	27.0	5	25.4(0.678)
Market	27	27.0(0.425)	53	27.0(0.347)	1	30.0	81	27.0(0.269)

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system

Apart from season, butter prices also differed at the three sales outlets, thus sales outlet was the other factor that determined butter price in Metema (Table 39). In this respect, farm gate price was the lowest during both seasons. During wet season, farm gate price was on average ETB 2.50 and ETB 1.60 less than delivery system price and open market price, respectively (Table 39). Where as, the price difference at the latter two sales out lets was fairly small and only ETB 0.90. By contrast, during the dry season, open market price was ETB 3.00 and ETB 1.60 higher than the average price at farm gate and delivery system sales out lets, respectively. Also the average price at the latter sales out let exceeded that of the former by ETB 1.40 (Table 39).

Despite price differences at different sales out lets, the amount of butter supplied using farm gate and delivery system sales out lets was insignificant compared to the quantity of butter sold at open markets. As a result, farmers (producers) cannot make use of these differences to

wards their advantage. For example, during wet season, the price when using delivery system was higher, but framers were unaccustomed to deliver butter to clients or at least the system was not well established even in Gendawuha town, to benefit from the increased price. Hence, sales out let as determinant of butter price in the district have less significance in benefiting the producers.

As a third factor, location difference was the other determinant of butter price in the district. Regarding this, butter price was similar in the two rural areas but the market price in Gendawuha town was on average ETB 3.00 more to the price in the two rural areas during dry season. Where as, differences between the town and rural price in wet season was trival (Table 39). Although such is the case, rural farmers (producers) would not benefit from the increased market price at Gendawuha town during dry season, because they do not bring their butter to Gendawuha market. Rather traders were the one who benefit from the difference. Hence, the effect of location as determinant of butter price has little advantage to words benefiting rural producers.

Color of butter was also considered as an indicator of butter quality by big traders, who took butter to markets outside the district. As discussed with the traders, they believed that yellow color of butter was not favored by traders. Yellow color might be resulted from too much usage of spices or adulteration of butter by mixing of oil and imported butter. Since the big traders have taken butter to Gondar town, Tigray and Gel bat (one of the border town of Sudan), yellow color of butter was not preferred by the customers of the big traders in these town, instead they preferred butter oil with out spices. However, the effect of butter color on

price was not observed during the survey period, except that yellowish butter color was discriminated by the big traders who take butter out side the district.

In general, when comparing the price of butter in the district to that of current prices in different areas in the country, the average price of butter is much cheaper in Metema than many places. For example, Ayantu (2006) reported that the average price of butter in Wolayta area was 23.7 ETB in wet season and 29.7 ETB in dry season, which is quite expensive than the price in Metema.

4.12.3.2. Butter marketing chains and channels

Marketing chains

The general picture of butter marketing chains in the study area was summarized in figure 6. The figure indicated that even though the marketing chain seems short, market agents from the study area, Gondar town and Tigray region were participated.

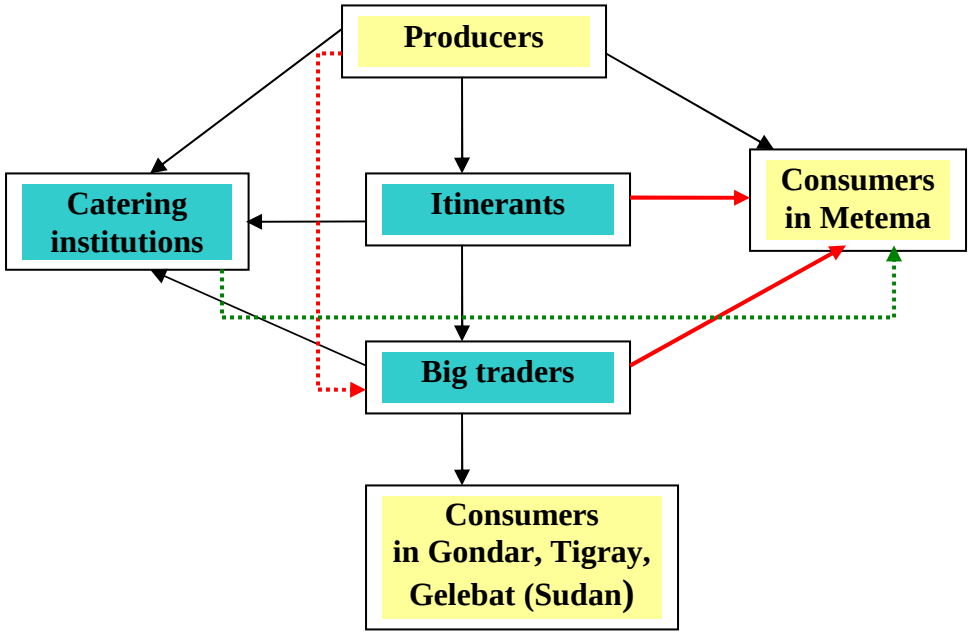


Figure 6: The general picture of butter marketing chains in Metema

Butter marketing channels

From the previous discussion, it has been obserbed that even though it was very difficult to indicate the relative significance of each channel in the marketing process, seven alternative butter-marketing channels were identified. The lists of channels were:

Producers → Consumers (BS_1)

Producers → Itinerants → Consumers (BS_2)

Producers → Itinerants → Big traders → Consumers (BS_3)

Producers → Catering institutions → Consumers (BS_4)

Producers → Big traders → Consumers (BS_5)

Producers → Itinerants → Catering institutions → Consumers (BS_6)

Producers → Itinerants → Big traders → Catering institutions → Consumers (BS_7)

Note that BS_1 to BS_7 referred to butter supply route of each channel. According to information gathered from producers and different butter market agents BS_2, BS_3 and BS_5 were the most common marketing channels through which large proportion of total cooking butter flows from the producers to consumers. As opposed to the present work, Aklilu (2004) reported a relatively short dairy product marketing channels in Amhara region, where the majority of consumers purchased dairy products directly from the producers.

4.12.3.3. Butter flows in and out side the district

Data collected from butter producers, traders and other key informants indicated that butter produced in Metema district could flow with in and out side the district. The produced butter was primarily used to satisfy local needs and then the surplus was directed to scarce areas of

the district. Butter produced in the study area was also taken to other areas (outside the district). Firstly, butter produced in Metema district was taken to markets in the highlands of North Gondar zone (Chilga, Gondar town). Secondly, next to North Gondar, places in Tigray region were the second level terminal markets for butter produced in Metema. Thirdly, butter in the form of butter oil (with out addition of spice) was exported to Gelebat (a border town in Sudan), and the transaction was legal and conducted based on the 2000 cross border trade agreement signed between the two countries (Ethiopia and Sudan).

4.12.3.4. Source of market information

As discussed with producers and itinerants, accessing actual butter market information was a very difficult task for farmers and itinerants in the studied areas, since there was no direct information source. The farmers at times discuss with each other when they get together at the village or market place about the time of increased demand for butter and try to predict the time when the price increases. Some producers and itinerants created some customers (big traders), and they usually trust the information they get from these customers. Thus, the price that these customers offered was often accepted by the farmers. In general, producers had no access to butter market information from direct sources, in particular the market situation prevailing in the surrounding towns, and regional cities that receive butter from Metema. As discussed with the big traders, such kind of information was accessed from recipient traders in terminal markets through telephone and other means of communications. Thus, producers (farmers) and to a lesser extent itinerants in Metema are always at the mercy of the big traders, who transport butter to areas outside the district.

The present observation is similar to the findings of Aklilu (2004), who also reported a general lack of livestock market information from direct sources in Amhara region, which he classified the information source as underdeveloped and traditional. Obviously, when the only source of market information for farmers is through informal communication with the big traders who purchase their product, no doubt that the farmers can be unfairly treated and exploited. Thus, concerned governmental agencies should periodically transmit market information through mass media (such as radio, television) at least concerning the major products produced in different parts of the region, such as butter from Metema. Nowadays, FM radio stations have been established in different regions and getting radio airtime to broadcast such information should not be an impossible as it used to be some years back.

4.13. Meat and cattle marketing in Metema

4.13.1. Experience of meat market

Cattle producers

As discussed in meat utilization section, none of the interviewed farmers were involved in selling raw meat or processed meat (Quanta), and farm households in Metema produced fresh meat or processed meat for own household consumption. As opposed to the present work, processed camel meat (Olobe), which is produced by farm households is available for sale in urban markets of Afder zone in Somalia region (Ahmed *et al.*, 2003).

Other business oriented individuals

During group discussion, it was pointed out that there were some farmers, who occasionally slaughter non-productive cattle and sell fresh meat in the form of local system called *kome*

(Medebe). The quantity of *kome* was small and its average cost was estimated as ETB 10-25. Even though these individuals basically work for business purpose, they were not licensed as well as their supply was small and irregular. These individuals mostly concentrated in and around small towns in the district.

Butcher houses

Although few in number, there were permanent butcheries in Gendawuha town and Metema Yohans (boarder town), who slaughtered cattle and provided meat to consumers. The butchers in the study area reported that cattle could be slaughtered at any time except during the main Ethiopian Orthodox fasting period (February through early April) and other shorter fasting periods (such as, the first 15 days of *Nehasie* and 30 days preceding (Christmas) as well as during Wednesday and Fridays of the lean months. Although the number of cattle slaughtered per day differed from butchery to butchery, the number of cattle slaughtered per day/butchery was one. Cattle were slaughtered at an open area reserved by the municipality for this purpose, however the place was simply open field with out shade, fence or other basic infrastructure (such as slaughter house bristling and cleaning facilities). Even ante mortem and postmortem inspection was not performed. Generally, the place did not fulfill the basic minimum requirements to be considered as abattoirs. Despite this, the municipality collected 10 ETB as service fee per head of cattle slaughtered. As a result, the municipality should give due attention to minimize the occurrence of public health hazard from Zoonotic and other contaminated diseases.

The quantity of meat sold was measured in kilogram or '*kome'* but the latter was widely employed. Kome composed mixtures of bone and flesh and one *kome* in butcher house was estimated to weigh between 0.5 and 0.75 kg and was sold between 6-7 ETB. Note that the quantity of kome as well as the price in butcher houses was smaller than the kome set by rural business individual, who occasionally provided butchering service in rural areas. Where as, the average cost of one kg meat at butcher houses was between 28 and 30 ETB. As gathered from butchers, once fixed the price of meat often remained constant or probably showed increment.

4.13.2. Cattle marketing

The farmers in the district reared cattle for multipurpose tasks, i.e., for milk, meat as well as draft power. As indicated in table 33, the farmers usually sell cattle when they become poor in productivity and/or when there is shortage of money in the household. As gathered from key informant, cattle were sold as the last option when the amount of money needed was not covered by other income sources (crops, butter and others).

As discussed earlier, Metema district is one of the gates to Sudan for cattle market flow and formal and informal (smuggling) export was practiced in the area. As farmers reported, up to 1996 E.C., export of cattle to Sudan markets was totally informal, in which cattle were smuggled through Tiha and Gelebat towns. Where as, in 1997 E.C official cattle export was started through Metema Yohanse by the agreement of both countries (Ethiopian and Sudan).

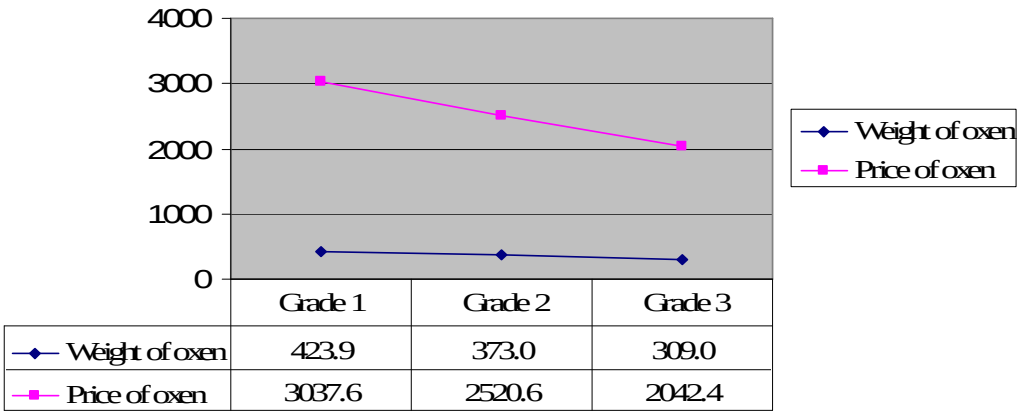
4.13.2.1. Cattle market supply and price

As discussed with cattle producers, traders, exporters and other market agents, because of the abundant supply of natural feed resources together with favorable environmental conditions

during the wet season (June-November), Metema district was a good source of oxen and bullocks for livestock purchasers. During the wet season, cattle body conditions usually improve with in short period of time and attracted good market price. However, during the dry season, the body condition of cattle severely deteriorates because of the high ambient environmental temperature and scarcity of feed resources and Metema ceases to be a source of marketable cattle to export to Sudan markets. Due to this reason, traders and exporters preferred to buy oxen and bullock from the highland areas for export during the dry season.

In Metema district, different age groups of cattle were supplied to the four major livestock markets (Gendawuha, Kokit, Meqa and Shinfa). Observation made during the fieldwork regarding the different cattle group supplied at these four different market places indicated that the supplied cattle at the market were 27.6% bullocks, 26.5% oxen, 21.3% cows, 17.2% heifers and 7.4% calves. During this month (December), the price of oxen was assessed and presented in figure 7.

As discussed with farmers, traders and exporters, in four market places oxen for meat purpose were supplied to markets majorly from September to December and cows for meat purpose from October to February. Where as, oxen for draft and cows for breeding purpose were supplied to markets from May to July. Like wise, heifers for replacement purpose could be supplied to markets from January to July.



	Grade 1	Grade 2	Grade 3
Weight of oxen	423.9	373.0	309.0
Price of oxen	3037.6	2520.6	2042.4

Figure 7: Weight measurement and prices of oxen at Metema livestock market.

4.13.2.2. Factors affecting supply and price

As discussed with cattle producers, traders and exporters, different factors influenced the supply, demand and price of cattle in Metema and these included season, distance to market, age, size and color of cattle.

i. **Age, color, and size of cattle**

Younger age, uncastrated, large frame size and good body condition, as well as colors other than black were highly demanded. Traders, exporters and other market agents preferred cattle of age group between 4 and 8 years. Market agents believed that cattle below and above this age interval yield poor quality meat. Even though the Sudan cross boarder cattle market greatly fluctuated, castrated bullock and oxen were demanded at Sudan markets around October, while uncastrated bullock and oxen were demanded between February and August. Nonetheless, in most instances, uncastrated bullocks were the top priority choice by the Sudan

importers and at times they sell with a price difference of ETB 200 - 300 compared to the castrated ones.

Regarding breed preference, Ruthana crosses and the Monastery cattle type were highly demanded at Sudanease markets because of their large size and good framework of their body. They could attract market easily and even the cattle seller could sell other non-attractive cattle type together with out intention of buying these non attractive ones if an individual had Ruthana and Monastery cattle types.

ii. Season of the year

Season was the other most important influencing factor for the supply and price of cattle in the study area. According to key informants, the months of the year were classified into four major periods. (1) The period from June to August: during this season, farmers need more money to pay for daily laborers hired for weeding and other agricultural activities. Thus, most farmers sold out different age groups of cattle. On the other hand, the Sudan importers were not interested to purchase large number of cattle during this season and therefore, the price of cattle was low. (2) The period from September to November: during this season, farmers harvest and sell their crops and have more income. On the other hand, the Sudan importers start to purchase more cattle and hence, the demand for oxen and bullocks starts to increase. As a consequence, the price of cattle becomes high during these months. (3) The period from December to March: during this season, the body condition of cattle declines because of high ambient temperature and shortage of feed resources. Therefore, the demand and price of cattle in Metema district declines during this time of the year. (4) The period from April to May:

oxen for draft purpose are highly demanded in Metema and farmers show less interest to sell their cattle. Thus, the supply of oxen and bullock reduces at market places and the price starts to rise.

iii. Distance to market

Out of the four major markets, three of them were located along the main road to Sudan, which divided the district in to two. Keble's located far from these market areas, such as Awassa, Achera, Shashge and Lencha were forced to sell their cattle at their farm gate with lower market price than the other kebles located nearer to these major markets.

4.13.2.3. Marketing agents in oxen market

In the studied area, six different marketing agents were participated in the transaction of cattle marketing. These included producers, middlemen (brokers), itinerants, cattle traders, exporters as well as consumers and the role of each agent is elaborated separately below.

A. Producers

The producers in the study area raised and provided different age group of cattle in to their respective market to meet the family need for cash income. Farmers' opinion obtained in the present work is more or less comparable with the idea of pastoral producers reported by Belachew and Jemberu (2003), in which livestock are usually sold to meet family needs for cash income, which is used to buy food grains and industrial products such as clothing.

As reported by farmers, cattle were not raised specifically to beef animals, rather they were meant to fulfill multi functions. On the other hand, some farmers were observed to integrate

the two functions of oxen, i.e., provision of oxen draft power and beef out put, and optimized the benefit obtained from oxen. These farmers used the oxen for ploughing during the wet season for a period of two to three months and there after fed the oxen for about a month time to improve their body condition and then sold them for a premium price. Since these farmers fed and sold the oxen while they were still young and in good body condition, they could benefit from their beef potential, while still fulfilling the requirements for draft power. Nonetheless, most farmers have not yet realized this dual advantage and were selling oxen only when they were out of production (old) and culled.

B. Middle men (Brokers)

In cattle marketing system, market middlemen (*Delala*) an important agents in facilitating the buying and selling activities. While buying, cattle traders usually inform the type of cattle they need and the middlemen guided the place where the specified cattle were coming from through their long experience as well as mediated the agreement between the seller and buyer. Besides, the middlemen acted as one of the members of eye witness while the transaction performed and the guarantee given. These middlemen have rendered this type of service with a commission. In most instances, they received 5 to 10 ETB per cattle when mediating cattle traders and producers (farmers), while they received 10 to 20 ETB/cattle when mediating exporters and Sudan importers.

According to the interviewed cattle traders, in most instances middlemen mediated 30% of the buying and 70% of the selling transactions. Where as, the interviewed exporters said 90% and 100% of transaction deals were performed through middlemen while purchasing and selling, respectively.

C. Cattle itinerants

This group included individuals, who are farmers or persons involved in other business but occasionally involved in cattle business. These agents usually traveled to distant locations in local areas to collect cattle with cheaper prices. They selected this activity to generate income and supplement income collected from other agricultural activities. The sources of their capital could be own sources or credit from individuals or ACSI (Amhara Credit and Saving Institution). The collectors could purchase different age group of cattle from different small local market place and farm gate of the producers in the district. However, the number of cattle purchased at any one time was very small, because of shortage of capital resources. The purchased cattle groups were sold at different market places of the district, particularly the meat purpose oxen and/or bullock sold to traders and exporters. Where as, cows and calves for breeding purpose, oxen and steer for drought purpose were sold to farmers.

D. Cattle traders

As discussed earlier in the case of itinerants, cattle traders composed of individuals, who were farmers or businesspersons performing other business activities. They started these activities to supplement other income sources of the household. These market agents purchased cattle from farmers and itinerants but in most instances from itinerants. The traders collected marketable different age groups of cattle at different market places and farm gate level of the producers and/or itinerants in the district. The volume of purchasing was higher than that of itinerants, because of the strength of capital resources. The sources of their capital could be own sources, credit from individuals or ACSI.

The purchased cattle were sold at different sales outlet (market places and/or farm gate) in the district. Moreover, oxen for meat purpose were sold to other traders and exporters, while cows and calves for breeding purpose, oxen and bullock for drought purpose were sold to farmers. The interviewed cattle traders reported that purchasing cattle had different objectives. Some of the traders purchased oxen for the purpose of selling them to other market agents. Some of the traders purchased oxen for using them for ploughing and then selling them after wards, while still some other traders said they purchased oxen for the purpose of renting them for draft purpose and then selling them after wards.

Since cattle traders in Metema district were not licensed, due to this reason, they did not travel from one market to another market area easily. With the aim of protecting illegal cattle trading (smuggling), Custom Authority branch at Metema district restricted movements of traders with out any license. Due to this condition, if the traders developed strength in capital sometimes traders rented license from legal exporters with payments of 120-150 ETB per head of oxen exported and sold their oxen and/or bullocks at Metema yohannes town to Sudan importers.

E. Exporters

This group composed of individuals, who were previously farmers, cattle traders or government workers. Most of the interviewed exporters were inhabitants of North Gondar Zone (Gendawuha and Gondar town). According to interviewed exporters, oxen and bullocks were the only official exportable cattle groups. The other cattle group such as cows, heifers and calves were not exported formally, rather they were exported informally (smuggling) to Sudan.

The exporters preferred to purchase exportable oxen from Metema district during wet season (June-November), while they preferred to purchase exportable oxen from the high land areas of Gondar and Gojjam during dry season (December-May). Exporters sold their cattle at the border town of Metema yohannes and inside Sudan (Khartoum). According to some exporters report 80% of the cattle were sold at Metema yohannes while the remaining 20% were sold inside Sudan (Khartoum). During the survey time, it was observed that cattle were sold to Sudan importers in-group (wholesale), in which a group of cattle contained 10 oxen. Cattle were transported using Isuzu tracks, which accommodated 10 oxen at a time. Thus, selling in groups of 10 oxen was meant to facilitate the loading and transportation of the cattle to Sudan.

As gathered from exporters, they had reservation about the distribution of license, which they said was given to individuals who were not actually involved in the business but rather rented to other individuals, who did not know the market well. Due to this reason, they said market stability was disordered and bankruptcy happened.

4.13.2.4. Cattle marketing channels and chains

Marketing chains

The general picture of cattle marketing chains in the study area was summarized in figure 8. The marketing agents participated in cattle marketing could be either from the study district, other neighboring district (such as Alefa, Quara, and Armachiho) and/or Gondar town.

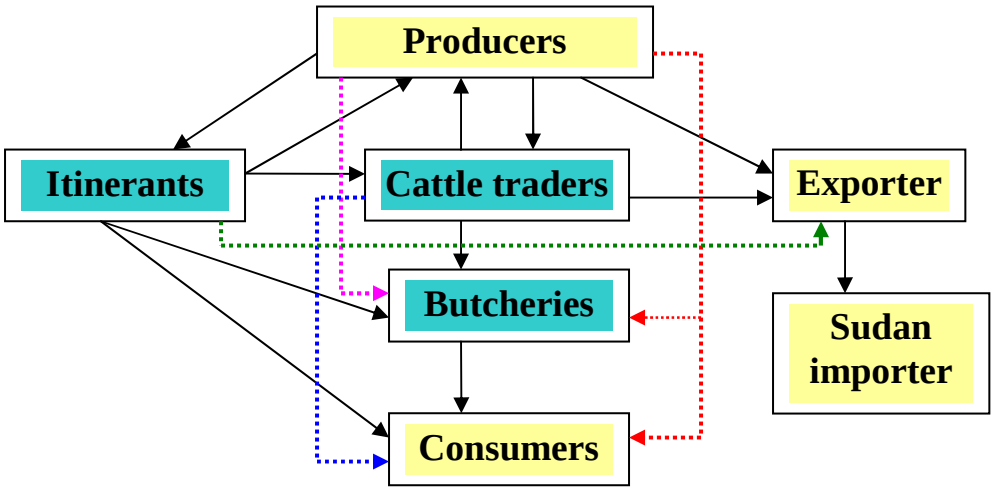


Figure 8: The general picture of cattle marketing chains in Metema district

Marketing channels

There were different marketing channels observed for cattle market in Metema district. The lists of channels were:

Producers → Itinerants → Cattle traders → Butchers → Consumers (CS_1)

Producers → Itinerants → Butchers → Consumers (CS_2)

Producers → Itinerants → Consumers (CS_3)

Producers → Cattle traders → Butchers → Consumers (CS_4)

Producers → Itinerants → Cattle traders → Exporters (CS_5)

Producers → Exporters (CS_6)

Producers → Itinerants → Exporters (CS_7)

Producers → Cattle traders → Exporters (CS_8)

Producers → Cattle traders → Consumers (CS_9)

Producers → Butchers → Consumers (CS_{10})

Producers → Consumers (CS_{11})

As discussed with the producers, itinerants, cattle traders and exporters CS_5, CS_8, CS_7, CS_{11} and CS_2, listed according to their importance, were the most common marketing channels through which the large proportion of cattle flows from the producers to consumers.

4.13.2.5. Cattle flows with in and out side the district

Data collected from cattle producers, itinerants, cattle traders, exporters and others key informants in the study area indicated that oxen and bullocks produced in the district flowed with in and out side the district. Any cattle group be it for breeding, draft or meat purpose flowed with in the district when inhabitants demanded them. Besides, great number of oxen and/or bullocks flowed to Sudan areas as beef source (said Sudan importers). Some of the key informants interviewed in the studied area believed that the Ethiopian cattle in Sudan have directly taken to the meat processing plants for slaughtering and meat processing. After the meat was processed, the canned meat could be exported to some part of Arab countries carrying the Sudan brand. On the other hand, some of the key informants also believed that the Ethiopian live cattle were exported by the Sudan exporters to Arab countries carrying Sudanease brand, i.e., as cattle raised or produced in Sudan.

4.13.2.6. Prior arrangement and mode of payment

Prior arrangement

In most instances, the market agents did not bother about relative relation ship at the market place, except only customer relation ship. So that with the exception of cattle exporters, any market agents have given a guarantor while selling any types of cattle. The guarantor should be a known individual in the near by area. Besides, a guarantee (written agreement), which were signed by both parties, guarantor and other three eyewitness members (*Emagn*) was

given to the buyers. Off course, the copies of the agreement were also kept in the hands of the seller and one of the eyewitnessed members. If some thing goes wrong, solution will be made with the help of their previous written agreement (guarantee). In most instances, the guarantee was given for rabbis, theft and other related cases.

Mode of payment

As cattle marketing agents reported, there are two mode of payment system exercised in Metema district cattle market, i.e., cash and credit system. Exercising the system was depended on the relation ships of the two market agents (buyers and sellers). If the agents were having frequent relation ship between the agents as a customer, the purchaser could have a chance of taking cattle with credit until it was sold. Other wise, it will not be given cattle for credit. However, in most instances, Sudan importors were interested to take oxen and uncastrated bullock with credit and payment will due with in one or two month's period. However, it was reported that some Ethiopian exporter had lost lots of money through this credit system by the Sudan importers. As cattle exporters reported, some times oxen and/or bullock selling with credit system seems very important. This is because if Sudan exporters were not willing to take oxen with cash, extra costs for awaiting the unsold animals, such as costs of feeds, herder and other expenses start to pile up with in day's interval. Therefore, in order to minimize extra costs, exporters preferred to give oxen and/or bullock on credit basis to Sudanease importers, even knowing the possible risk of not paid back. Therefore, exporters should be supported to have access to cattle awaiting station with affordable service charge so that they will not be forced to accept unfair transaction (unfair price, risky mode of payment etc). It is important that their animals be maintained in good body condition until sold or other wise the exporters can be easily bankrupted.

4.13.2.7. Cattle export in Metema

i. Unofficial export

Unofficial cattle export is the common activity in Metema district. Different cattle age groups were trekked to Sudan areas unofficially, mainly through the gate of Tiha and Gelebat. There are also other non-official routes in which cattle trekked to Sudan areas such as *Kergena*, *Serkeje*, *Wodebelisan* and *Amdebilo* (these all are near by Tiha). Tiha is one of the Sudan market at the border and it takes 6 hours walking from Shinfa small rural town. In most instances, Tiha was a livestock market from Monday to Sunday. According to the key informants, unofficial export through the gate of Tiha was started long years ago and still this gate served as a route for unofficial export. More over, the illegal traders showed that selling oxen at Tiha fetches ETB 400-500 difference than selling to the exporters inside Metema district. In these illegal routes different age group of both sexes of cattle were exported unofficially.

As gathered from the key informants, out of the total amount of cattle exported, the majority of cattle export (about 60%) was through illegal routes. However, the illegal traders explained that along the *Tiha* routes, there were different risks such as theft of cattle when the cattle are trekked and money when coming back after selling of cattle, mistreatment of Sudan and Ethiopian troops at the border were happening.

ii. Official cattle export

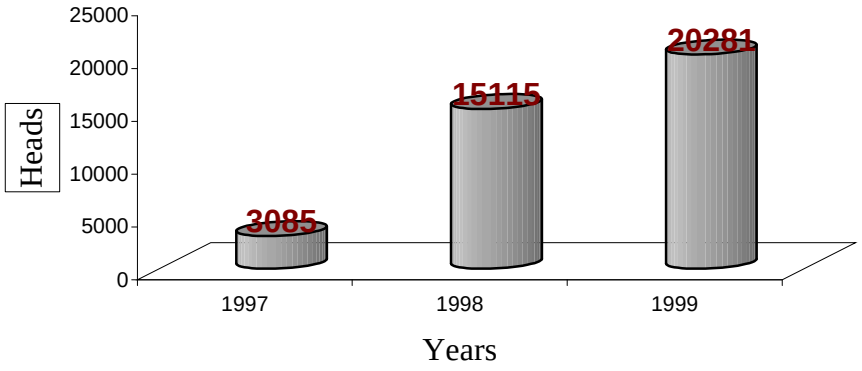
According to Metema branch of Custom Authority Office report, it was explained that informal cattle export was practiced before 1996 E.C. However, starting from 1997 E.C.

official cattle export was started. The exportable cattle groups, which have been given exit permission, were only oxen to Sudan market. Even though the office informed that the exportable oxen should be castrated and on average should weigh greater than 200 kg, as observed during the survey time, the office was reluctant to strictly follow up these restrictions and non-castrated oxen were also exported. This needs some precautions because of the uncastrated bullocks and the types of oxen exported to Sudan. Because it is believed that, every country should have its own brand concerning the commodity it is exporting. So we can keep this by exporting castrated oxen only as it was stated by the law of Ethiopian government cattle exporting principles.

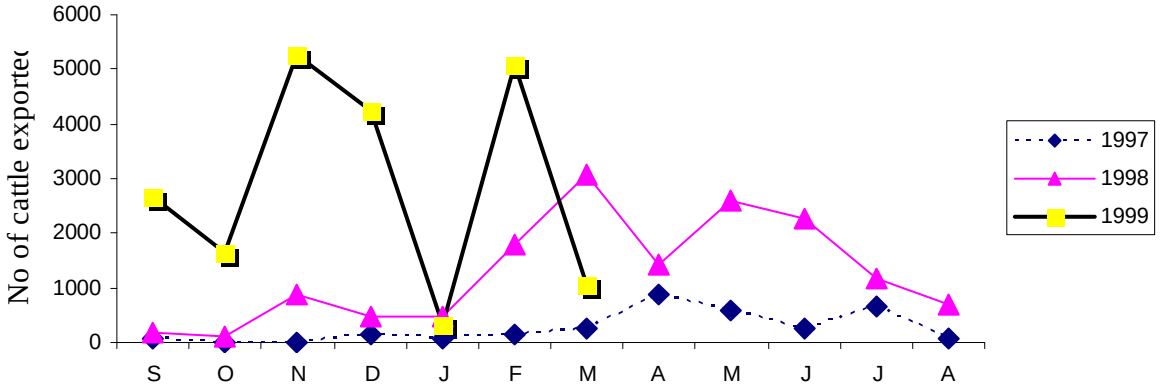
Even though it was not possible to retrieve information about the type of oxen exported (castrated or none castrated), the total heads of cattle exported with in three years were summarized in figure 9. Accordingly, in 1997 E.C. 3085 oxen were officially exported and in 1998 E.C., the figure raised to 15115, which was an increase by about 390% compared to the previous year. Between September and March of 1999, (in 7 months alone) officially exported oxen were 20281, and this again showed an increase of 34.2% compared to the annual export during the preceding year. In general, these figures indicate the growing importance of cattle trade across Metema district. In particular if conditions are made convenient for the exporters to use only legal means of export (ie, totally aboundan illegal smuggling or at least minimize it), these figures show how much the country could benefit from its cattle resources. However, the latter requires, making available suitable cattle awaiting stations with affordable cost, fair price for cattle at least comparable with the illegal market, secured business and other advantages that would attract exporters to use the legal route. The monthly distribution of

exported cattle indicated that exported quantities heightened during three periods namely during November to December, February to March as well as during May to June. The reasons for the increased quantity of exported cattle during these periods were discussed in earlier sections.

a) Oxen exported in different years



b) Monthly distribution of exported oxen



Source: Metema Customs Authority office, Metema branch (2007).

Figure 9: Oxen officially exported through Metema district in different years (a) and monthly distribution of the exported quantity of oxen (b).

Vaccination services before export

The exportable oxen were vaccinated for some transmittable disease before the permission was given. The vaccinated oxen were given ear tags to identify them from non-vaccinated oxen. Most exporters in the study area complained that there was a problem of vaccination service in Metema district. In most cases, vaccination service was given at Zonal office of agriculture (Gondar town), if the exporters want to vaccinate their exportable oxen, they will take to Gondar or do some illegal activities. Due to this reason, there were some illegal businesspersons observed in the area preparing illegal tag and sell to some exporters. Therefore, this needs great attention to protect illegal way of trading.

Service charge

While exporting oxen, with the exception of annual taxes, the service rendered by the Ethiopian government was almost free of charge. However, if the Ethiopian exporters want to sell their oxen inside Sudan (Khartoum), they should be charged ETB 400 per head of oxen.

4.13.2.8. Transportation of cattle

Producers, itinerants and cattle traders trekked their cattle to the market place on foot, mainly because using vehicle for cattle transportation was only given permission for licensed exporters. So that most of the time the exporters used small Isuzu vehicle that accommodate 10 oxen at a time (Figure 10). Some times FSR model Isuzu vehicle, which accommodate 20 oxen was used.

Figure 10: Means of oxen transportation by the exporters, photograph of Isuzu vehicle loading 10 oxen.

Loading and unloading facility

It is obvious fact that loading and unloading facility are the most important managerial activity to minimize risks for cattle and human beings, who are working. However, loading and unloading facilities were not well organized in the area. The exporter and official government bodies did not give much attention about this facility. Due to this limitation, exporters used places that were a little bit sloppy as a dock to load and unload exportable oxen (Figure 11). In this regards, the loading place at Gendawuha (Figure 11, a and b) some how had a sort of dock (although not properly made) to load the cattle. However, the worst situation existed while unloading the animals at the boarder town where this kind of dock was entirely lacking and the animals were simply forced to jump off the track (Figure 12).

a) Loading facility at Gendawuha town

b) While oxen are loaded at Gendawuha

Figure 11: Local loading facilities observed at Metema ditrict, a) represents one of the local types of loading facility at Gendawuha town, where as b) represents while the oxen was loaded to the Isuzu vehicles.

a.

b.

Figure 12: In appropriate ways of unloading oxen at the border of Metema district, particularly Metema Yohanse (a and b).

4.13.3. Source of market information

Market information systems, particularly for agricultural commodities are not easy to implement effectively. Too often, the information is not current or does not include sufficient

detail on product characteristics (Gordon, 2007). According to Barret (1997), efficient arbitrage depends fundamentally on farmers and /or traders having access to reliable information on market conditions, especially prices, prevailing at multiple locations.

As gathered from the interviewed producers, current cattle market price information at different market location was difficult to access, simply provided their cattle in their respective market places whenever they need cash. Some farmers provided cattle for sale at farm gate or market place level when ever they think there will be good market price from their past experience such as holiday or when the demand of traders was high. This observation paralles the report by Aklilu (2004), who noted that in Amhara region the majority of farmers obtained market information from neighbors, who went to market earlier or from local itinerants traders or traders from adjacent towns for market news.

Itinerants and cattle traders were relatively better in getting cattle market information from exporters and Sudan importers than producers. However, cattle market information values in terms of time and transparency was limited. As observed from the discussion with itinerants and traders, the authonticity of market information obtained from informal sources was 25%.

Cattle exporters were relatively better in getting reliable market information from domestic areas and Sudan importers through telephone communication. However, the information sources (i.e. Sudan importers) were themselves potential buyers and market prices so obtained can not be fully trusted. Thus, majority of exporters reported that the reliability of the information was more or less medium. Off course, some exporters assigned a fellow agent as a

source of price information in Khartoum. These types of exporters were better protected from different market risks, as they obtain fairly reliable information from their own agents.

4.14. Constraints related to milk and meat production and marketing system

As gathered from farmers and key informants, cattle milk and meat production and marketing system was constrained by a number of factors. As shown in appendix table 14, the most important livestock production constraints prioritized by the sampled farmers were theft of cattle, cattle diseases, tick and fly infestations, human diseases and low butter efficiency. The other most important constraints of production and marketing system were shortage of market information, shortage of feeds during the dry season, shortage of capital resources, shortage of water during dry season, lack of extension service. These constraints interactively affect the performance of the genetic potential of animals leading to subsistence level of livestock production. The most important constraints observed in the study area are elaborated in detail in the following section.

1. Lack of insecurity because of theft of cattle

Among the interviewed farmers, majority of them (50.84%) ranked theft as the number one problem that hindered cattle production greatly. During group discussion, it was pointed out that looting cattle was a common phenomenon, which at times forced farmers out of livestock production. Unless and other wise the government find a solution, the preponderance of farmers can end up with no cattle in a short period of time. During the survey work time at Shinfa market, some farmers were observed holding cattle of different age groups and when

they were asked why different aged groups were supplied to the market at a given time, they replied because of theft problem.

As gathered from key informants, some years ago, cattle were simply left to graze in the communal grazing land and forestland all day long with out any herdsman attending them and when the animals felt satisfied some time in the evening, they used to gather at some comfortable place to rest for the night. Thus, the duty of the herdsmen was simply to locate the spots where the cattle rested to protect them from predators. Despite this, now a days, farmers were seen herding their cattle closely in near by areas of their village. Even herding was performed during day and night time with strong herdsman in order to protect theft. More over, even though it was temporary, every farmer used open fenced areas (with out shade) for over night guarding from theft and even then, they are not immune from looting.

According to some farmers explanation, among the different cattle age group, oxen were highly exposed to theft. This was because oxen in Sudan areas at different market were highly demanded. In most instances, cattle looted from somewhere else in the district or other neighboring districts were smuggled to Sudan areas. Therefore, in order to sustain livestock production and marketing development, in general, this problem should be given due consideration and addressed by the stakeholders at district and regional level.

2. Cattle diseases

Among the interviewed farmers, 20.33% ranked cattle disease as a top prioriety problem. As gathered during group discussion, farmers believed that the transhumant cattle were one of the

major sources of cattle diseases. Farmers stressed that most of the parasitic sources of diseases were transmitted from transhumant cattle. The most important diseases identified were babesiosis, Lumpy Skin Disease (LSD) and thrypanosomiasis.

As it was observed during the survey work, disease caused cattle mortality was not severe rather loss in productivity due to sickness was immense. These results were were more or less comparable with the previous study conducted in north and west shewa zone, where the major factors responsible for the declining of livestock population were feed shortage (50%) and disease (22%) (Agajie *et al*., 2002).

3. Human diseases

Considerable proportion of the interviewed farmers (18.64%) also rated human diseases as the first priority problem of loss in productivity in the district (Appendix table 14). Among others, farmers pointed out that malaria infection and acute diarrhea were the most prevalent diseases in the district. In most instances, these diseases occurred towards the end of rainy seasons. However, malaria cases were also observed at the beginning and ending of rain. Due to these disease problems, the productive ages group some times became idle and unproductive during the main production season (rainy period).

4. External parasites

Overall, 10.16% of sampled farmers ranked external parasites as first priority problem, which caused significant loss in livestock productivity. The most dominant external parasites observed in the area were ticks and flies. Farmers believed that babesiosis disease occurred

during periods of high tick infestation and this is quite correct observation as babesiosis is a tick borne disease. Therefore, to minimize the problem occurred due to babesiosis disease, effective control measures of tick infestation needs paramount attention. Biting flies were the other most important external parasites and mostly occurred at the ending of rain, particularly during the month of September. During this time, cows become restless due to biting flies and withheld milk let down during milking. As a result, milk production often declines during peak fly infestation times. Apart from the loss of milk, other effect of biting flies on livestock production is not well known and this requires research attention.

5. Compositional quality of ergo and low butter out put

Naturally fermented milk (Ergo) was a common dairy product in the study area, however at times the cured formed becomes watery and when this type of fermented milk is churned, it gives poor butter yield. As a matter of fact, several factors can cause undesirable fermentation of milk, such as, ambient temperature, unheiginic handling of milk, disease etc., however the exact cause for this problem has not been considered in the studied area. Since the problem is quite frequently observed in many households, it requires due research attention.

As gathered from farmers during group discussion, low efficiency of butter fat recovery was the other main concern that challenged butter out put. The reason given by the farmers for low butter fat recovery in the area was because the prevailing hot environmental temperature causes fat granules to melt during churning and pass with the buttermilk. However, the exact reason for this problem has not been identified through scientific investigation and research work need to be conducted to find out the cause as well as methods of processing (churning) that improve efficiency of butter fat recovery.

6. Lack of feed conservation and utilization management

Even though Metema district had abundant natural feed resources during the wet season, animals suffer from shortage of feeds coupled with very hot environmental conditions during the dry season (December-May). Shortage of feeds is more severe in the months of March-May. During this time, the animals were provided with crop residues, small amount of concentrate (oil seed cake and *embaze* to very emaciated animals), tree leaves and acacia tree seedpod. In addition, cattle were taken to distant areas where dried stand hay is available.

As a matter of fact, the area has abundant natural feed resources (vast grazing land had various fodder species) that can be conserved and used as feed source during the dry season. Even though most of the interviewed farmers reported as they seen conserving fodder in the form of hay, the quality was quite poor as well as insufficient quantity to supplement the animals through out the dry period. This problem is quite soluvable as there is substantial fodder source from the vast grazing lands only if the farmers are adequately supported through extension interventions.

The other problem, which contributed to shortage of animal feeds, was frequent firing of grazing and forest lands. Farmers said that firing was mostly started around November. Even though the reasons seemed unorthodox, farmers said firing occurred due to carelessness by wild beekeepers (Honey hunters) and at times deliberately by farmers and cattle looter. Farmers used firing for the purpose of avoiding snakes and other reptiles, while looters set fire at near by grazing grounds for the purpose of placing cattle away from people residence. Whatever the cases, uncontrolled firing of grazing areas and forestland should be protected so

that forage in the form of stand hay can be available in the vicinity of the villages to be used during the dry period. It should be stressed that standing hay is the main source of fodder during the dry season and it needs to be protected from fire.

7. Lack of market information

Butter and cattle market information was not obtained from direct and trusted sources (such as government media) as well as not to merly delivered to the producers in the district. During the group discussion with producers, itinerants and traders, in most instances, the producers were most vulnerable to loss of market price due to limitation in accessing market information. Even though, itinerants, traders and exporters were relatively in a better position, they also suffred from market price transparency. Though public media (radio, bekur magazines) was serving announcement of price of the major commodities at different location weekly, almost none of the market agents were utilizing information due to unawarness.

8. Lack of service (Extension, Inputs, and Veterinary)

As discussed with farmers, most farmers lack appropriate services of extension, veterinary and inputs. Farmers reported that livestock production was not assisted by appropriate extension services regarding feed management, improved husbandry practices, product processing, marketing and so on. According to the farmers report, the extensional service was not focused in assisting how to conserve feeds, fattening cattle, how to utilize milk and milk products and husbandry practices. Due to this reason, they followed traditional production system instead of improved system.

Previously, experiences with any objectives of the traits had not been practiced to change the genotypes of the indigenous cattle; rather the production system was dependent on only indigenous cattle types. How ever, recently with the collaboration of IPMS Ethiopia and MOA, Borena cattle type (bull) was introduced.

Despite the existence of high disease incidences, there was no adequate animal health service provided parallel to their way of production system. In order to minimize disease incidence the herdsman was equipping themselves with common medicine and syringes, if the cattle showed any sign of abnormality, they injected common medicine by themselves. Therefore, instead of letting farmers to do this by them selves, a mobile clinic by technician or any veterinarians needs to be arranged.

5. SUMMARY AND CONCLUSION

The traditional cattle production system practiced in Metema district is composed of crop-livestock mixed production system and transhumance production system. In Metema district different livestock species were found, of which cattle composed the highest livestock population (56.6%). The average number of cattle herd size was 15.53 heads per household.

The main functions of livestock rearing in Metema district were as a source of milk and milk products (48.9%), income (26.9%) and draft power (24.3%). On the other hand, the role of cattle to provide manure, meat, hide and skin was considered as secondary functions.

Cattle types in Metema district are composed of entirely locals, which included locally called Agew, Simada and Fogera cross. Moreover, Ruthana and Felata cattle types, which were believed to be originated from Sudan and Niger were found in small proportions. Breeding system was entirely natural mating using local bulls available in the area. Among the sampled farmers, 65.8% of the farmers practiced selective breeding, while the rest (one third) left their cows for open mating. In cotton based farming system areas, cattle holdings were higher than the two studied areas. As a result, farmers practiced selective mating as well as used their own bull for breeding in CBFS than the other studied areas.

The feed resources used for cattle in Metema area were natural grazing (31.0%), crop residues (29.5%), crop aftermath (21.8%) and hay (17.8%). In addition to these major feed resources, local oil extraction by products (sesame cake), Niger seed cake and local brewery products were also used to a lesser extent.

Three types of diseases were identified as major health problems of cattle in Metema district and these involved tick infestation (37.2%), Babesiosis (31.6%) and Foot and Mouth Disease (15.6%). Most households (94.9%) reported disease occurrence in cotton based than in Gendawuha town (86.2%) and in sesame based farming system (83.8%). Livestock health problem was not fully addressed in Metema district, because of shortage of veterinary expertise and related facilities. Since disease is one of the major threats of livestock production in the district, livestock health management in Metema district as a whole needs urgent attention.

Average milk off-take of indigenous cows was about 1.9± 0.045 liter/cow/day, while average lactation yield was 324.0±10.274 liters. Average lactation yield obtained was significantly higher ($P<0.05$) in Gendawuha town than in the two rural areas. Average lactation length of indigenous cows was 5.9±0.14 months ranging from 2 -12 months. Average lactation length in Gendawuha town was significantly ($P<0.05$) higher than the values obtained in cotton based and sesame based farming system areas. Mean AFC and CI of indigenous cows were 4.5±0.05 years and 17. 9± 0.31 months, respectively. Average CI and weaning age of calves were significantly higher in Gendawuha than in the two rural areas.

Whole milk, fermented milk (*Ergo*), buttermilk (*Wegemit*), whey, butter and cottage cheese (*Ayib*) are among the common dairy products produced and consumed with varying degree of utilization. Out of the total volume of whole milk produced, 18% was consumed by the household and 63% retained for processing and 13% used for calf feeding. On the other hand,

out of the total volume of butter produced, more than half of it was consumed with in the household (58%) and one-fourth (25%) was provided to market. However, the market share of whole milk and other milk derivatives such as cottage cheese, buttermilk and fermented milk was almost negligible. Particularly, whole milk was not a marketable commodity in Metema district. These results indicated that dairy production in Metema is less market oriented. Since these limitations have great impact on the improvement of dairying, in general, there is a need to strengthen extension activities to intensify milk production in the area and to change the attitude of farmers toward fresh milk sale. Establishment of marketing infrastructures could encourage them to change this trend.

Milk processing in the study area was entirely based on sour milk (Ergo). Milk was fermented for about 26.53±1.23 and 34.9±0.82 hours in dry and wet season, respectively. High proportion of households performed churning with in 24 hours interval during dry season (83.33%) than during wet season (59.54%). while during dry season. Churning methods vary, and include placing the churner on the floor, hanging the churner on tripods or churner is shacked with both hands.

Relatively few farmers were involved in cattle fattening activities in Metema and the main constraints were lack of experience (34.9%), shortage of labor (30.8%), feed shortage during dry season (17.5%) and shortage of capital (15.9%). Cattle are usually sold for slaughter when they are too old for ploughing and milk production. Cash shortage also forced farmers to sell their animals with out finishing. Farmers who were involved in fattening usually purchased emaciated oxen when the price of cattle decreases, and keep them on natural grazing for 15-30

days and sell with attractive price when their body condition improves. Evidently there is a wide prospect for farmers to benefit from fattening such as potential feed sources (vast grazing land) and cattle source. However, realization of this potential requires a good deal of extension intervention such as training farmers about improved fattening activities as well as providing them with necessary inputs.

Meat is not consumed during the long fasting period by the followers of Ethiopian Orthodox Church. Meat consumption was mainly during seasonal occasions. The main source of meat in Metema was small ruminants slaughtered individually (44.9%) and by close neighbors and related families for distribution among themselves (43.2%), while 11.9% of the respondents reported purchasing meat from butchers house. Out of the total fresh meat produced, 49.8% was consumed by the household in the form of fresh, while 50.2% was retained for processing. Traditional method used for processing meat was air-drying method and the product produced is locally called '*Quanta*'.

52.2% of households had experience of selling milk and milk products, while the remaining (47.8 %) had no experience of selling dairy products. 93.1% of inhabitants of Metema district depended on butter as a marketable commodity, while (7.0%) used whole milk, naturally fermented milk (Ergo) and buttermilk as a marketable commodity. However, no experience of selling traditional cottage cheese (Ayib) was reported. The dairy marketing system identified in the study area was entirely informal marketing system, in which the producers sell dairy products directly to consumers and/or traders. From the over all data, average butter prices ranged from ETB 22.5 to EB 25.0/liter in wet season, while the price was fairly higher during

the dry season (ETB 24.0 to 27.0/liter). The most common butter marketing channels were [3]BS2, BS_3, and BS_5 through which the large proportion of total cooking butter flows from the producers to consumers. Where as, the most common cattle marketing channels were [4]CS_2, CS_5, CS_7, CS_8 and CS_{11} through which the large proportion of cattle flows from the producers to consumers.

In general, milk and meat production and marketing system were constrained by theft of cattle, infectious and parasitic disease, lack of milk processing services, poor market information on the price and supply condition, lack of services (extension, inputs, and veterinary) and lack of feed processing and utilization management. Therefore, to improve the situation, use of better-feed conservation and utilization techniques, use of improved feeding system and improved animal health services are believed to solve these problems. In order to achive these, provision of training to the farming communities is imperative so as to improve their knowledge and skills on the management of dairy and beef animals.

[3] BS is abbreviated as Butter marketing system,
[4] CS is abbreviated as Cattle marketing system

6. RECOMMENDATION

Based on the current survey study, the following key recommendations have been developed.

- Cattle keepers in Metema district produced more surplus milk per capita than their fellow highlanders during the rainy seasons. If this significant amount of milk could be supplied to the market, a good source of income can be created for the inhabitants. There is a need to strengthen extension activities to increase milk production in the area and to change the attitude of farmers toward fresh milk sale. The establishment of organized milk collection and marketing infrastructures would encourage them to change these trends. Hence, support must be given to improve the attitude of inhabitants through awareness creation.

- Dairy producers in Metema district complained that the prevailing high temperature causes undesirable fermented milk, which often gives low butter yield when churned. Thus, comparative investigation on the different processing techniques should be required.

- The communal grazing land produced abundant pasture in wet season, but not during dry season. This resulted in feed shortage during the dry season. One of the means to minimize feed shortage is conservation of forage in the form of hay at the end of rainy season. However, lack of experience in haymaking hinders the practice. Hence, due consideration should be given to train the farmers in haymaking. It is also important to go beyond providing farmers with simple illustration of haymaking practice, and support them to form cooperatives that could help them to have access to the use of

machinery that can mow and carry the mowed grass from distant communal pasture to homestead.

- Even though disease is one of the major constraints of livestock production system in Metema area, inadequate veterinary services were rendered because of shortage of veterinary expertise and related facilities. Thus, efforts should be made to establish adequate services at least at the farmers training center areas. The trained paravet at keble level should be distributed in the other kebles too, with adequate medications. The senior vet staff of agricultural office should supervise them regularly.
- Informal export of cattle to Sudan areas was a common phenomenon and not only oxen but also cows, calves and heifers were informally across the boarder exported. Due attention should be given to restrict movement of cattle across the border through legal provision as per the agreement of Ethiopian and Sudan government.
- The potential sources of feeding pasture and sesame cakes for cattle fattening in the study area should be well utilized through continual and appropriate awareness creation. In addition, extension work should also focus on provision of training to farmers regarding improved fattening practices, such as appropriate age of cattle for fattening, length of fattening, feeding and other necessary management aspects.
- Looting cattle in Metema district had great influence on the livestock production. The community along with local governments should address this problem through effective dialogue and control mechanisms.
- According to the respondents during the month of September, biting flies contributes to the decrease in milk yield of cows. However, the claim of reduction in milk yield due to biting flies needs further investigation.

- Most farmers in Metema areas used different plants for smoking the milk vessels. These plants should be tested and given scientific research explanation about its importance and safety to consumers. In addition, farmers reported that smoking the milk equipments would result in higher butter yield production. Thus, the idea of the farmers should be further investigated and given scientific explanation.

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8. APPENDICES

Appendix table 1: ANOVA test on family size under the two farming system and Gendawhua town.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming System	26.896	2	13.448	2.828	.061
Error	1269.711	267	4.755		
Total	1296.607	269			

Appendix table 2: Religion, ethnic and primary occupation of household heads in Metema district.

	[*]CBFS		*[**]SBFS*		*Gendawuha*		*Overall*	
Variables	HHC	%	HHC	%	HHC	%	HHC	%
Types of religion:	N = 60		N = 180		N = 30		N = 270	
Orthodox	60	100.0	166	92.2	25	83.3	251	93.0
Muslim	0	-	14	7.8	5	16.7	19	7.0
Ethnic group:	N = 60		N = 179		N = 30		N = 269	
Amhara	60	100.0	166	92.2	23	76.7	249	92.6
Tigray	0	-	6	3.3	6	20.0	12	4.5
Gumz	0	-	4	2.2	0	-	4	1.5
Agewu	0	-	2	1.1	1	3.3	3	1.1
Oromo	0	-	1	0.6	0	-	1	0.4
Primary occupation:	N = 60		N = 180		N = 30		N = 270	
Farmer	60	100.0	171	95	28	93.3	259	95.9
Trader	0	-	7	3.9	0	-	7	2.6
Government worker	0	-	0	-	2	6.7	2	0.7
Driver	0	-	1	0.6	0	-	1	0.4
Carpenter	0	-	1	0.6	0	-	1	0.4

[*] CBFS = Cotton based farming system, [**] SBFS = Sesame based farming system, HHC = Household count

Appendix table 3: ANOVA test on landholdings of households including large enterprise farms in cotton based, sesame based farming system, and Gendawuha town.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming system	2044.098	2	1022.049	3.674	.027
Error	72041.075	259	278.151		
Total	74085.173	261			

Appendix table 4: ANOVA test on average landholdings of households excluding large enterprise farms in cotton based, sesame based farming system, and Gendawuha town.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming system	128.746	2	64.373	5.924	.003
Error	2618.664	241	10.866		
Total	2747.41	243			

Appendix table 5: ANOVA test on cattle holding/ household under the two farming system and Gendawhua town in Metema district.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming system	1476.896	2	738.448	5.683	.004
Error	34696.367	267	129.949		
Total	36173.263	269			

Appendix table 6: ANOVA test on the effect of farming system difference on cattle herd structure.

Sources of variation	*Sum of Squares*	*df*	*Mean Square*	F_{cal}	*Sig.*
Farming system	243.926	1	243.926	33.815	.000
Cattle type	4947.620	5	989.524	137.176	.000
Farming System * Cattle type	228.198	5	45.640	6.327	.000
Error	11599.383	1608	7.214		
Total	44818.127	1619			

Appendix table 7: ANOVA test on milking cows holding in cotton based, sesame based farming system and Gendawuha town.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming system	31.358	2	15.679	2.516	.083
Error	1657.460	266	6.231		
Total	1688.818	268			

Appendix table 8: Summary of ANOVA test result regarding the effect of farming system on various productive and reproductive parameters of local cows in the three studied areas of Metema district. Note that degrees of freedom for farming system are 2 in all the tests.

Variable	*Error df*	*MS error*	*MS Farming system*	*F value*	*P*
Milk yield/day/cow	264	0.459	10.828	23.586	.000
Milk yield/lac/cow	260	17110.410	1412061.305	82.526	.000
Lactation length	261	3.543	216.488	61.095	.000
Weaning age	260	19.093	282.477	14.795	.000
Age at first calving	261	.346	2.374	6.864	.001
Calving interval	259	23.228	338.881	14.589	.000
Calf crop	256	3.455	108.007	31.263	.000

Appendix table 9: ANOVA test on average total milk yield produced per day per household.

Source of variation	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Farming system	641.593	2	320.796	12.735	.000
Error	6322.833	251	25.191		
Total	6964.426	253			

Appendix table 10: Reasons why milk was not practiced in cotton based, sesame based farming system and Gendawuha town.

Variables	**CBFS*		***SBFS*		*Gendawuha*		*Overall*	
	HHC	%	HHC	%	HHC	%	HHC	%
Reasons for not selling milk:	N=57		N=172		N=29		N=258	
Not supported by the community		28.1		19.1		17.2		20.8
No excess milk for selling		31.6		55.2		51.7		49.8
No market access		40.4		18.0		3.4		21.2
Need of other dairy products		0.0		7.7		27.6		8.2

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Appendix table 11: The reasons for the choice of butter out let in cotton based, sesame based farming system and Gendawuha town during wet seasons.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	HHC	%	HHC	%	HHC	%	HHC	%
Farm gate selection:	N = 5		N = 4		N = 1		N =10	
Good price		40		25		0.0	3	30
Short distance		40		50		100	5	50
Reliable customer		20		25		0.0	2	20
Delivery system selection:			N = 5				N = 5	
Good price			1	20			1	20
Short distance			3	60			3	60
Reliable customer			1	20			1	20
Market place selection:	N = 40		N = 63		N = 1		N = 104	

Good price	85.4	76.2	0.0	79.0
Short distance	9.8	3.2	0.0	5.7
Reliable customer	4.9	19.0	100	14.3
Mode of payment	0.0	1.6	0.0	1.0

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Appendix table 12: The reasons for the choice of butter out let in cotton based, sesame based farming system and Gendawuha town during in dry seasons.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	HHC	%	HHC	%	HHC	%	HHC	%
Farm gate selection:	N= 1		N =2		N = 1		N =4	
Short distance	1	100	2	100	0	0.0	3	75
Reliable customer	0	0.0	0	0.0	1	100	1	25
Delivery system selection:			N = 4		N = 1		N = 5	
Good price			1	25	1	100		40
Short distance			3	75				60
Market place selection:	N= 27		N=54		N=1		N = 82	
Good price		78.6		81.5		0.0		79.5
Short distance		3.6		1.9		0.0		2.4
Reliable customer		17.9		14.8		100.0		16.9
Mode of payment		0.0		1.9		0.0		1.2

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC = Household count

Appendix table 13: Butter mode of payment at different sales outlet in wet and dry season in cotton based, sesame based farming system and Gendawuha town.

Variables	*CBFS		**SBFS		Gendawuha		Overall	
	HHC	%	HHC	%	HHC	%	HHC	%
Wet season:								
Farm gate	N =5		N =4		N =1		N =10	
Cash	5	100	4		1	100	10	100
Delivery system			N =5				N =5	
Cash			5				5	
Market	N = 40		N = 61		N = 1		N =102	
Cash	40	100	61	100	1	100	102	100
Dry season:								
Farm gate	N =1		N =2		N =1		N =4	
Cash	1	100	2	100	1	100	4	100
Delivery system			N =4		N =1		N =5	
Cash			4	100	1	100	5	100
Market	N =27		N=54		N =1		N =85	
Cash	27		54		1		85	

* CBFS = Cotton based farming system, ** SBFS = Sesame based farming system, HHC =

Appendix table 14: Constraints identified and prioritized by the households in Metema area. Numbers in the table are households, who rated the respective constriats as a top priority problem.

Variables	*CBFS		**SBFS		Overall	
	HHC	%	HHC	%	HHC	%
Constraints:	N=14		N= 45		N = 59	
Cattle theft	7	50.0	23	51.1	30	50.84
Cattle disease	4	28.6	8	17.8	12	20.33
Human health	2	14.3	9	20.0	11	18.64
External parasites	1	7.1	5	11.1	6	10.16

Annex 1: Questionnaire used for base line data-collection.

Enumerator's name ---------- ----------

Respondent name ---------- ----------

Respondent name number --- ---------- ----------

Region ---------- ----------

District ---------- ----------

Kebele ---------- ----------

Date interviewed ---------- ----------
Time of interview started ----------
Time of interview end ----------

Section 1. General information

1. Respondent's Status in family: 1. Head 2. Wife 3. Son 4. Daughter 5. Others
2. Sex: 1 = Male 2 = Female
3. Age of head of household _____ Yrs
4. Education of the head of household: 1 = No formal 2 = Adult literacy 3 = Primary
4 = Secondary 5 = Beyond secondary
5. Religion of head of the household: 1 = Orthodox 2 = Muslim 3 = Protestant 4 = Other (specify)
6. Ethnic group of head of the household: 1. Amhara 2. Tigray 3. Oromo 4. Gurage
5. Gumz 6. Shinasha 7. Agwu
7. Main occupation of the household head: 1. Farmer 2. Retired 3. Trader 4. 1 and 3
8. Household size and composition:

Age group (years)	No. of members in the household		
	Male	Female	Total
>60			
16-60			
6-15			
<6			

** Include all persons living permanently in the household and taking food from the same kitchen.

9. Household Composition and Occupation

#	List of members name	(1) Relation to HHH	(2) Marital status	Age	(3) Sex	(4) Education	(5) Occupation			
							Rainy season		Dry season	
							Major	Second	Major	Second

Codes: Household Composition and Occupation

1. Relation to household head:
   1=Household head 2=Spouse of head 3=Child of head/spouse
   4=Parent of head spouse 5=Sibling of child of head/spouse
   6=Grandchild of head/spouse 7=other relative to head/spouse 8=Unrelated to family
   9=Hired labor 10. Wife
2. Marital status: 1 = Single 2 = Married 3 =Widowed 4 = divorced
3. Sex: 1 = Male 2 = Female
4. Education: 1 = Illiterate 2 = Read and write 3 = Elementary 4 = High school
   5= Beyond secondary school
5. Occupation:
   1 = Farmer 2 = House wife 3 = Student 4 = Herder 5 = Trader 6 = Handicraft maker
   7 = Unemployed
   8 = Government employed 9 = Employed non government 10= House maid 11= retired
   12= Other

10. Landholdings:

#	Land area	Land use	Ownership status	Tenure arrangement	If rented, rental shares (%)	Distance rom homestead
1						
2						
3						
4						
5						

Codes:

Land use: 1 = annual crops; 2 = forest/trees; 3 = grassland; 4 = orchard; 5 = perennial crops; 6 = fallow; 7 = others

Ownership status: 1 = owned; 2 = rented in; 3 = leased in; 4 = rented out; 5 = leased out; 6 = other (e.g. Invaded)

Tenure arrangement: 1 = share cropping; 2 = fixed rent after harvest (leasehold); 3 = fixed rent before harvest; 4 = others ----------

11. Livestock inventory during the previous year (heads)

Species	Starting no. (head)	Breed	Born	Bought	Shared-in	Gift-in	Barter-in	Barter-out	Died	Sold	Slaughtered	Shared-out	Gift-out	Current (heads)
1. Cattle														
Ox														
Cow														
Bull														
Heifer														
Steers														
Male calf														
Female calf														
2. Sheep														
3. Goats														
4. Camel														
5. Mule														
6. Horse														
7. Donkey														
8. Chicken														
9. Beehives														
11. Others														

Note: Starting number refers to number of heads 12 months ago.

Section 2. Milk production, consumption and marketing system.

2.1. Milk production.

12. Type of Producer: 1 = Specialized dairy farmer (dairy main source of income)
2 = Crop-livestock farmer (balanced income from crop & livestock)
3 = Small/landless dairy farmer (none or little crop land, 1-2 cows)
4 = Livestock production only.

13. Dairy herd size, composition and milk yield:

#	Types of Species and breed	Number of dry animals	Number of Pregnant	Number of Milking animals	Yield per day (liter)	
					Dry season	Wet season
1	Crossbred cows					
2	Local cows					

14. What was the main purpose of cattle rearing (Keeping?)
    1. For milk purpose 2. Meat purposes 3. Meat and milk purposes 4. Drought purposes
    5. Manure purposes 6. Social functions 7. Income source 8. Others (Specify) ----------
    ** Rank them in order of importance, 1. ---- 2. ------ 3. ------- 4. -------5. ------ 6. ------ 7. ---------
15. When did you start dairy farming?
    1. 1 years ago 2. 2 years ago 3. 4 years ago 4. 5 years ago 5. Long years ago

16. How do you get information on better feeding practices, breeding practices, processing, and marketing practices? How to improve your husbandry practice?
    1. From radio 2. Simply I follow traditional way 3. I read news paper
    4. I will discuss with farmer associations 5. From agricultural extension agents
    6. From family back ground
17. Have you been provided with extension services? 1. Yes 2. No
18. Have you ever taken any dairy training course? 1. Yes 2. No
    18.1. If yes when? Explain the advantages? ----------
19. Productive and reproductive performance.

#	Parameters	Cattle type			
		Cross breed	Locals	others	
1.	Age at first service (months)				
1.	Age at first calving(months)				
2.	Average lactation length (days)				
3.	Average lactation yield(liters)				
4.	Daily production per animal, peak period (liter)				
5.	Daily production per animal, lean period (Liter)				
6.	Weaning age (months)				
8.	Length of post partum period (days)				
9.	Average number of offspring given through out their life				

20. How much produced per household?

#	Volume produced	Unit	Dry season	Wet season
1.	Milk/day			
2.	Butter/week			
3.	Cheese/week			
4	Fermented milk			

* Specify months in each season.

21. Which type of breed produces the best quality of milk and milk products?
    1. Fogera type 2. Fultata type 3. Rutana type 4. Cross breed 5. I don't know others.
22. What are the parameters used to evaluate its quality?
    1. Fat content of milk 2. Taste and flavor of milk 3. Color of the milk
    4. Capacity of fermenting
23. What initiate the cows for milking?
    1. The calf 2. Giving feed while milking 3. Given rock salt 4. Other (Specify) ---------.
24. For how much time the calf stayed with his dam to suckling?
    1. For 10 minutes 2. 20 minutes 3. 15 minutes 4. 5 minutes
25. Do you know how much milk is taken by the calf? 1. Yes 2. No
    25.1. If your answer is yes, how much? -------- Liters
26. How much teats the calf will suckle? 1. One teat 2. Two teats 3. Three teats 4. Four teats
27. What are the milking practices observed in your dairy farming?
    1. Alternate suckle and milk? 2. Once suckle and milk?

Breed and breeding

28. What is your breeding system?
    1. Natural breeding 2. Artificial breeding 3. Both
29. If your breeding system is natural, what are its mechanisms?
    1. We select the best type of bull and we inseminate our cattle
    2. We don't have any selection activity, simply we used uncontrolled breeding
    3. Others ----------
30. Do you have an experience of selection the best cattle type for breeding purpose?
    1. Yes 2. No
31. If yes what are your parameters used to select the best cattle for breeding purpose?
    1. Color coat 2. Behavior of the animals 3. Body conformation
    4. Milk production potential 5. Drought power potential 6. Others ----------
32. How did you get your crossbred cow?
    1. Purchased from neighbors
    2. Purchased pregnant cow from any project (ILDP)
    3. Purchased from market 4. Through A.I. 5. Supplied by the MOA.
33. When you start having cross bred cows?
    1. One years ago 2. Two years ago 3. Six months ago 4. Three years ago 5. Others
34. Why you start with Cross breed cows/heifers?
    1. Better milk production 2. Higher growth rate 3. Higher weaning weight
    4. Better body conformation.
35. Why you only stick with Local cows?
    1. Better disease resistance quality 2. Better resistance on heat stress.
    3. Better fat content 4. I don't get cross breed cows/heifers
    5. Better body conformation 6. They can fit for Drought purpose
    6. I don't know other means
36. Do you have an experience of using AI? 1. Yes 2. No
37. If no, why did not use it?
    1. We did not know its advantages 2. We did not have any option to get AI service
    3. We did not have interest for Crossbreeding 4. Environment will disfavor them.
    5. Others ----------
38. If you are only sticking on local animals, what was the source of your bull?
    1. Own source 2. From neighbors 3. From every where source 4. others
39. What type of a local bull you prefer?
    1. Fogera type 3. Fulata type 3. Rutana type 4. I used the unknown 5. Simada type
    5. Others
40. Do you have any major reason for your preference?
    1. Body conformation 2. Milk production 3. Better milk quality 4. Better traction power
    5. Others Rank the reasons: 1. ----- 2. ------ 3. ------- 4. -------- 5. -------
41. What are the major problems in getting cross breeding services?
    1 = Places are too far 2 = It is often difficult to get the inseminator
    3 = Payment for crossbreeding service is too much high 4 = I don't hear about crossbreeding
42. What are the major problems in managing crossbred dairy cows.
    1. Feed problem 2. Disease problem 3. Lack of labor 4. Lack of water
    5. Lack of money 6. Other Rank: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____
43. Why did you want cross breeding services?
    1 = To get more milk 2 = To get more drought power. 3 = Other (specify)
44. Do you know how much milk liter you obtained from your local cows ?
    1. Yes 2. No
    44.1. If yes, how much liter on average you get?

Per day --------- liter
Per lactation --------- liter

45. Cost of production inputs for cattle (during the previous year).

#	Material inputs	How much
1.	Medicine	
2.	Veterinary services	
3.	Vaccine	
4.	Drenching	
5.	Deworming	
6.	AI	
7.	Breeding fee	
8.	Salt	
9.	Ropes	
10.	Cleaning materials	
11.	Others	

46. Labor inputs for cattle production (Please indicate by a check mark (√) who performs the activity).

#	Activity	Family labor (√)							
		Husband		Wife		MC		FC	
		W	D	W	D	W	D	W	D
1.	Cutting and carrying of grass and other green roughage for feeds								
2.	Tethering								
3.	Giving supplementation								
4.	Watering								
5.	Herding on the grazing land								
6.	Collection of animal manure from the field								
7.	Cleaning pens/barns								
8.	Washing animals								
9.	Milking								
10.	Delivery of milk to collection centers								
11.	Churning of milk								
12.	Transporting animals for marketing								

Codes:
a. AM = adult male; AF = adult female b. W = wet season c. D = dry season.
d. Family Labor: 1. Husband 2. Wife 3. Male children (MC) 4. Female children (FC)
5. Other hired personnel

47. How do you feed milk to the calves?
1 = Bucket feeding 2 = Suckling

48. If it is a bucket feeding, how many liters and for how long are given?
1 = Morning milk _____ lts, for ---------- days
2 = Evening milk _____ lts, for ---------- days

49. What type of feed is given to the calf immediately after weaning?
1. Simply leave to graze in the field 2. We just give crop residues.
3. We don't differentiate with the old one. 4. We don't care them.
5. We give them Local oil seed cake (Embaze) 6. Others

50. When do you start giving hay/concentrate to your calf?
1 = After 3 month 2 = After 6 Month 3 = After 1 Year 4 = Other (specify)

51. If you are giving concentrate and hay to your calf how much you give per day? ---------- kg

Watering the animals

52. What is the water source of cattle? 1. Pond water 2. River water 3. Tap water
53. What is the frequency of watering your animals?

#	Species	Frequency	
		Wet season	Dry season
1.	Cross breed		
2.	Locals		

Codes:
Frequency: 1 = Once in a day 2 = Twice in a day 3 = Three times in a day
4 = Other (specify)

54. How far the water points from your home? _____ Kms round trip.
55. Do you think availability of water is a major constraint during the dry period?
1 = Yes 2 = No
56. If the answer is yes, how did you alleviate the problem?
1. By digging the ground water 2. By going long distance to the river. 3. Other means

Feeds and feeding

57. What are the sources of feed?
1. Natural grazing land 2. Crop residue 3. Crop after math
4. Concentrate 5. Brewery product (atela) 6. Hay 7. Embaze 8. Others
Rank them: 1. ---- 2. ----- 3. ----- 4. ------ 5. ------ 6. ------ 7. ----- 8. ------
58. DO you have an experience of making hay? 1 = Yes 2 = No
59. If yes, from which land?
1 = Individual Pasture land 2 = Crop land (after math) 5. Cultivated grass
3 = Roadside grass 4 = Community pasture land 6. Other (specify)
60. If no, what was your major reason?
1. We did not know about its importance. 2. We don't have any feed shortage.
3. We can let our animals simply to the dried grass.
4. Since we do have large number of cattle, we can not accommodate all.
5. It has no importance.
61. What are the crop residue sources?
1. Teff 2. Millet 3. Sorghum 4. Sesame 5. Maize 6. Rice 7. Others
Rank them: 1. ----- 2. ----- 3. ----- 4. ----- 5. ----- 6. ----- 8. -------
62. What about the crop residue utilization.

#	Utilization (%)	Type of crop residues					
		Teff	Millet	Sorghum	Sesame	Maize	Other
1.	feed						
2.	mulch/compost/l						
3.	housing material						
4.	Burned						
5.	other purposes						
6.	Sold						

63. Did you come across shortage of animal feed? 1. Yes 2. No
64. If yes, Can you mention at what months feed shortages exist?
1.
2.
3.
65. If yes, what was your solution to alleviate your problem?

1.
2.
3.

66. Do you produce cultivable forages?
    1 = Yes 2 = No
67. If yes, what type of forages do you produce?
    1 = Sesbania 2 = Oats & vetch 3 = Tagasate 4 = Lacuna 5. Other (specify)
68. If no, what was your reason?
    1. I did not hear any thing about it. 2. Even though I heard, I don't get the seed.
    3. I don't have any shortage of feeds 4. I don't have any extra land to cultivate
69. Do you purchased feed for your animals?
    1 = Yes 2 = No
70. If yes, from where you purchased?
    1 = From neighbor of settlers. 2 = From farmers in other PA
    3 = From market 4 = 1 and 2 5 = 1, 2 and 3 6 = From near by town
71. If yes, what type of feed purchased?
    1. Hay 2. Oil seed cake 3. Wheat and corn bran and middling 4. Embaze 5. Others
    Rank them: 1. --- 2. ----- 3. ------ 4. ------ 5. -------
72. If yes, how much feed was purchased?

#	Types of feed purchased	Total amount purchased per year	Price per unit
1.	Hay		
2.	Oil seed cakes		
3.	Embaze		
4.	Crop residues		

Health condition

73. Do you have any animal health problems? 1 = Yes 2 = No
74. If yes, what are the major animal health problems? Please rank in order of importance.
    1. Foot and mouth 2. Liver fluke 3. Lung worm
    4. Black leg 5. Anthrax 6. Pneumonia
    7. Ticks 8. Blood urinate 9. Mitch 10. Other specify
    Rank: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____
75. How did you overcome the problem? Explain? ----------
76. What are the local plants used for medication to livestock?
    1.
    2.
77. Do you have any chance of having health clinic in near by your residence?
    1. Yes 2. No
78. If yes, how many km you will go to get this health clinic? --------- Kms

Manure disposal and utilization.

79. Is manure collected during the previous year? 1. Yes 2. No.
80. If yes, how much is produced per day? ------- quintals.

81. If yes, what looks like its utilization?

#	utilization	Ruminants				Non-ruminants		
		Cattle	Camel	Goat	Sheep	Equine	Chicken	Other
1.	fertilizer							
2.	fuel							
3.	feed							
4.	other purposes							
5.	sold							

82. Do you have a chance of selling manure? 1. Yes 2. No
83. If yes, how much you sell per unit?
---- Unit.
----- Birr.

Housing system

84. What is the importance of housing?
1. To protect from hot climate 2. To protect from cold weather
3. To protect animals from wild animals 4. To protect the animals from theft
4. It has no importance especially for cattle 5. Others ----------
85. Do you have an experience of housing your dairy animals? 1. Yes 2. No
86. If yes, what type of housing system?
1. Simply crashes 2. Open with roof on the top only
3. I keep the animals with the people residence 4. I tethered at the yard
87. If no, why you don't use house for the dairy animals?
1. They are great in number 2. We don't have stationary place
3. If they acclimatize the outside environment, they became strong enough.
88. At what time the house is needed?
1. During summer 2. During winter 3. No specific time. 4. Others -------
89. Do you have a selection of species for housing? 1. Yes 2. No
90. If yes, what are the species privileged for housing?
1. Cattle 2. Sheep 3. Goat. Camel 4. Equines 5. Others
Rank them with priority: 1. ---- 2. ---- 3. ----- 4. ---- 5. -----
91. Do you have an experience of age of cattle selecting in housing? 1. Yes 2. No
92. If yes, for what age group you give priority?
1. Small calf 2. Milking cows 3. Oxen 4. Dry Cows 5. Fattened animals
6. Heifers and Rank them with the priority given: 1. ---- 2. ----- 3. ----- 4. ----- 5. ----- 6. -----

2.2. Dairy product utilization

93. How the dairy products are utilized from total amount of production?

#	Dairy products	Proportion in percent	
		Wet season	Dry season
1.	Raw milk		
	Given to the calf		
	Consumed		
	Given off to the other people		
	Given of to calf herder		
	Sold		
	For further processing		
	Others		
2.	Fermented milk(Ergo)		
	Consumed by the family		

	Given off to the other people		
	Sold		
	For further processing		
	Others		
3.	Butter milk(Wegemit)		
	Consumed by the family		
	Given off to the other people		
	Given to the calf		
	Sold		
	For further processing		
	Others		
4.	Butter		
	Consumed by the family		
	Given off to the other people		
	Hair dress		
	Sold		
	For further processing		
	Others		
5.	Cheese		
	Consumed by the family		
	Given off to the other people		
	Sold		
	For further processing		
	Others		

94. Is there any problem concerning dairy product utilization? 1. Yes 2. No
95. If yes, what is that?
    1. Milk should not given to the outsiders
    2.

2.3. Milk processing

96. Do you have an experience of processing the dairy products?
    1. Yes 2. No
97. If yes, what are the processed products?
    1. Butter 2. Butter milk 3. Cheese 4. Ghee 5. Fermented milk 6. Others
    Rank them in a priority: 1. --- 2. –-- 3. ----- 4. ---- 5. ------ 6. -------
98. Member of any Cooperative or Association or dairy development project.
    1. Yes 2. No
99. If yes, what is the benefits you were provided
    1. Credit supply 2. Gives market information
    3. Collects our product and sell to the market.
    4. provides inputs with least cost 5. Guaranteed sales outlet
    6. Supply the inputs 7. For profit distribution
100. If yes, what was its obligation?
    1. Paying monthly member ship contribution.
    2. Participate by labor when ever it is needed.
    3. Repayment of credit.
    4.
101. Do you know the purpose of fermenting milk for a certain period of time?

1. Yes 2. No

101.1. If yes, what was the reason?

1. It gives us good flavor and taste. 2. It helps for churning of fermented milk.
3. It is a means of preservation. 4. Other reasons --------

Rank them with priority: 1. --- 2. ---- 3. ---- 4. ----

102. How long does the milk will be stored for fermentation before it is processed in to butter?

#	Length of the time(Days)	Wet season	Dry season
1.	Minimum days		
2.	Maximum days		
3.	Average days		

103. Do you have an experience of smoking your milking cans and other related materials?

1. Yes 2. No

104. If yes, what are its advantages?

1. For good and pleasant flavor and taste 3. For good shelf life of the products
2. For killing microorganisms. 4. Others.

Rank them; 1. --- 2. ---- 3. ----- 4. -------

105. What are the plants or the materials used for smoking your milking equipments?

1. Wenbela 2. Gorgora 3. Abalo 4. Ader

106. What matters whether the processing is ready or not?

1. Milk volume 2. The color of the fermented milk
3. Physical compactness of the fermented milk 4. Others

107. How many hours does it take to churn fermented milk into butter?

#	Length of the time(hours)	Wet season	Dry season
1.	Minimum hours		
2.	Maximum hours		
3.	Average hours		

108. What are the materials used for churning of milk in the process of butter making?

1. ---------- 2. ----------

109. Give the volume of fermented milk churned to produce 1 kg butter?

#	Total amount (Local unit)	Wet season	Dry season
1.	Minimum amount		
2.	Maximum amount		
3.	Average amount		

110. What about the frequency of churning of fermented milk into butter during wet season?

1. Every two weeks 2. Once in a week 3. Every 24 hours
4. With in three days interval 5. With in four days interval 6. Specify (other)

111. What about the frequency of churning of fermented milk into butter during dry season?

1. Every two weeks 2. Once in a week
3. Every three weeks 4. With in three days interval
5. With in four days interval 6. Specify (other)

112. For how long do you store butter before selling?

Minimum ------ months
Maximum ------- months

113. If you store your butter for a certain period, do you have an experience of adding something in it? 1. Yes 2. No

114. If yes, what are the materials added?

1. Salt 2. Spices 3. Only cook with heat 4. Others --------

115. What are its advantages?

1. For coloring 2. For taste 3.

116. Do you process buttermilk into cheese? 1. Yes 2. No
117. If yes, what matters the time of cooking?
1. The amount of butter milk 2. The type of material used for cooking
2. The amount of heat is given 4. Others ---------
118. If yes, how much butter milk is required to produce 1 kg cheese? ---------- liter
119. If no, what should be your reason?
1. It will be consumed by the family 4. There is no cheese market 3. We don't want to produce cheese
2. It will be consumed by the calves 5. Others
120. Do you process butter in to other product? 1. Yes 2. No
121. If yes, what are the products?
1. Cooked butter 2. Spiced butter 4. Salted products
122. If yes, what are the materials used to process butter?
1. 2. 3.
123. What is the importance of processing butter?
1. For preservation 3. For long period of storage
2. For good flavor and taste 4. For good market value
Rank them: 1. --- 2. ----- 3. ----- 4. ------

2.4. Dairy product marketing

124. Do you have an experience of selling the dairy products? 1. Yes 2. No
125. If yes, what the dairy products you are going to sell?
1. Raw milk 2. Fermented milk (Ergo) 3. Butter 4. Butter milk
5. Cheese 6. Whey milk
Rank them in the order priority given: 1. ---- 2. ---- 3. ----- 4. ---- 5. ---- 6. -----
126. Do you have an experience of selling raw milk? 1. Yes 2. No
127. If no, what was your reason?
1. Milk is forbidden to sell due to traditional problem.
2. There is no excess milk for selling. 3. No market access 4. Market place is too far.

128. Sales of the dairy Products and Prices:

#	Dairy products	Unit	Wet season				Dry season			
			Outlet 1	Outlet 2	Outlet 3	Outlet 4	Outlet 1	Outlet 2	Outlet 3	Outlet 4
1.	Raw Milk									
	Sales outlet									
	- Reason for choice of outlet									
	Buyer type									
	Qty per day									
	Price/liter									
	Mode of payment									
	Distance traveled/day									
	Time spent/day									
	Transport cost/day									
2.	Fermented milk									
	Sales outlet									
	- Reason for choice of outlet									
	Buyer type									
	Qty per day									
	Price/unit									
	Mode of payment									
	Distance traveled/day									
	Time spent/day									
	Transport cost/day									
3.	Butter									
	Sales outlet									
	- Reason for choice of outlet									
	Buyer type									
	Qty per week									
	Price/unit									
	Mode of payment									

	Distance traveled/ week									
	Time spent/ week									
	Transport cost/ week									
4.	Butter milk									
	Sales outlet									
	- Reason for choice of outlet									
	Buyer type									
	Qty per week									
	Price/unit									
	Mode of payment									
	Distance traveled/ week									
	Time spent/ week									
	Transport cost/ week									
5.	Cheese									
	Sales outlet									
	- Reason for choice of outlet									
	Buyer type									
	Qty per week									
	Price/unit									
	Mode of payment									
	Distance traveled/ week									
	Time spent/ week									
	Transport cost/ week									

Codes:

Sales outlet: 1 = Farm gate 2 = Market place 3 = Delivery to buyer

4. Others ----------

Mode of payment: 1 = Cash 2 = Cash in advance 3 = Credit 4: _____

Type of buyer: 1. Urban consumer 2. Rural consumers 3. Trader

4. Tea house and hotels 4. Hospital/school

5. Collection point of /private/Cooperative enterprise

Reason for choice of outlet: 1 = Good price 2 = Short distance

3 = Reliable customer 4 = Mode of payment 5 = _____

129. Which species milk is preferred by the consumers?
1.Cow milk 2. Sheep milk 3. Camel milk 4. Goats milk
Rank them in the order of importance 1. ----- 2. ----- 3. ------- 4. -------
130. Do you know why they preferred milk from this species? 1. Yes 2. No
131. If yes, what are the attribute preferred?
1. The color of the milk 2. The solid content of the milk
3. The fat content of the milk 3. the salt content of milk
4. Other ---------
132. From which breed of cow do you prefer to sell milk?
1. Crossbreed 2. Local cow in general 3. Fulata cattle
4. Rutana cattle 5. Fogera 6. I don't know others except mine. 7. All type of cattle.
133. Is there a demand for milk in your area? 1. Yes 2. No
134. If no, what should be the probable reason?
1. Consumers did not want to buy from other producers.
2. They do have their own cattle for milking
3. Others. ---------
135. If yes, where do they get?
1. From the farmers who produce in the area.
2. From the nearby town. 3. Other sources ---------
136. How much is a liter of milk in your village _____ birr/it
137. How much is a liter of milk in your nearby town _____birr/it
138. Is there any significant price difference in the milk of cross-breed and local cow? 1. Yes 2. No
139. If yes, please indicate from which type of milk you get the highest price
1. From local in general 2. From cross-breed
140. Is there any milk taste difference between cross bred and local cow?
1. Yes 2. No
140.1. If yes, which type of cow milk has the best taste?
1. Crossbreed 2. Local Fulata cow 3. Local Rutana cow
5. Local Fogera 6. Local cow in general
141. Who from the household delivers the milk to the buyers?
1. Husband 2. Wife 3. Adult male children 4. Adult female children
5. Child 6. All members of the HHH 7. Hired labour
Rank them: 1. ----2. ----- 3. ----- 4. ------- 5. ----- 6. ------ 7. ------
142. Has any of your milk intended for sale been rejected because it had become sour? 1. Yes 2. No
143. If yes, what percent of the time
1 = 75 % of the time 2 = 50 % of the time
3 = 25 % of the time 4 = Specify (other) ----------
144. Which milking is mostly rejected?
1 = Morning 2 = Evening
145. What should be the main reason?
1. It will be sour 2. Others ----------
146. What is the main reason for being sour?
1 = Non availability of buyers.
2 = Because of the distance to the delivery point
3 = Because of preservation problem
4 = 2 and 3 5 = Specify (other) ----------

147. How much do you get from sale of the following product/year?

#	Commodity type	Maximum (Birr)	Minimum (Birr)
1.	Raw milk		
2.	Butter		
3.	Cheese		

148. When is the best time to sell more raw milk?
1 = Wet season 2 = Dry season

149. What are your probable reasons?
1. We do have more production 2. We do have more market
3. There are no more fasting periods 4. Others --------

150. When is the best time to sell more butter?
1 = Wet season 2 = Dry season

151. What are your probable reasons?
1. We do have more production 2. We do have more market
3. There are no more fasting periods 4. Others --------

152. When is the best time to sell more cheese?
1 = Wet season 2 = Dry season

153. What are your probable reasons?
1. We do have more production 2. We do have more market
3. There are no more fasting periods 4. Others --------

154. Do you obtain different prices for butter and cheese depending on how many days you keep it before selling?1 = Yes 2 = No 3 = No Idea

155. Who in the household decides, on how the income is spent?
(Put check mark)

Income source	Husband (1)	Wife (2)	Both (3)
1. Income from sale of crop			
2. Income from sale of animals			
3. Income from sale of wool			
4. Income from sale of milk			
5. Income from sale of straw			
6. Income from sale of cow dung			
7. Income from sale of butter			
8. Income from fire wood			
9. Income from cheese			
10. Other incomes.			

156. How do you overcome the household problems which have been created?
1. Saling of live animals 2. Saling of Butter 3. Saling of milk 4. Saling of crop
5. Selling of cheese 6. Others -------
Rank them with the priority: 1. ----- 2. ----- 3. ------ 4. ------ 5. ------- 6. ----

Section 3. Meat production, utilization and marketing system

3.1. Meat production

157. When your animals is becoming out of production, what are you going to do?
1. Simply keeping them until they die
2. They will be taken to the market for selling
3. A little bit giving feeds and improves body conformation and sell.
4. Others ----------

158. Do you practice fattening? 1. Yes 2. No

159. If no, what is your problem/
1. I don't know its advantages
2. We don't have any market for the fattened animals
3. There is feed shortage
5. I am not interested to practice this
6. I do have other duties
7. I don't have family. 8. No credit service

160. If yes when did you start?
1. 6 months ago 2. A year ago 3. Two years ago 4. Others (Specify)

161. If yes, why you were started?
1. It has good market benefit.
2. I have been told by the extension agent.
3.
4.

162. Where do you get the sources of livestock?
1. Own source. 2. Purchased from the community 3. Purchased from the market
4. Shareholding with other person 5. Others.

163. What types of animals are needed by the fattening operation?
1. Aged animals 3. Livestock which became out of production
3. Livestock with dental problem 4. We don't have any preference 5. Others ------

164. What types of breeds are preferred for fattening?
1. Indigenous Fogera breed 2. Local Fultata breeds 3. Local Rutana breeds
5. Simada 6. Unknown indigenous 4. Cross breeds
Why it is preferred? ----------.

165. What are the age groups of cattle most of the time used for fattening purpose?
1. Heifers 2. Steers 3. Cows 4. Bulls 4. Oxen
Why it is preferred? ----------.

166. How many times you were fattening with in a year?
1. One time 2. Two times 3. Three times
4. One time with in two years interval.

167. What months are preferred for fattening?
1. ----------
Why this time is chosen? ----------

168. How many months you will keep animals for fattening?
1. One month 2. Two months 3. Three months 4. Four months 5. Five and above months.

169. Which one is more appropriate and good from the above choice?
1. --------
Why? ----------

170. How do you know whether the animals are fattened or not?
1. By weight measurement
2. By physical body conformation.
3. When the skin became shiny 4. When every bone is covered by meat
4. Others ----------.

171. Do you castrate your animals before you start fattening? 1. Yes 2. No

172. If yes, what is its importance?
1.
2.
3.

173. Do you have an experience to record weight before you start feeding and other managements? 1. Yes 2. No

174. If yes how much weight differences you achieved on the time of selling?
1. Minimum --------- Kg. 2. Maximum --------- kg.
175. Did you get extension service from any agents (MOA, NGO, and other?)
1. Yes 2. No
176. If yes, did you get improvement in your capacity 1. Yes 2. No
Explain? ----------

Meat utilization.

177. Do you consume meat? 1. Yes 2. No
178. If no, what was your reason?
1. We don't have access to meat
2. Culturally it is not possible to eat meat
3. Others ----------
179. If yes, what was your time of consumption?
1. During Main holiday (Easter, New Year, epiphany ...)
2. During occasions Any other time 4. Others ----------
Rank them with priority: 1. ----- 2. ------ 3. ----- 4. -------
180. Where do you get this meat for consumption?
1. Own animals 2. Purchasing animals from others 3. Other source
4. Purchased from butchers
181. How much produced and utilized?

#	Meat produced on farm	Cattle	Goat	sheep
1.	Number of animals slaughtered/year			
2.	Slaughter weight (kg/head)			
	Total raw meat consumed (kg)			
	Total raw meat sold (kg)			
	Selling price per kg on farm-gate			
	Total raw meat for further processing(kg)			
3.	Air dried meat			
	Total produced			
	Total air dried meat consumed (kg)			
	Total air dried meat sold (kg)			
	Selling price per kg on farm-gate, Birr			
4.	Salted meat			
	Total produced			
	Total salted meat consumed (kg)			
	Total salted meat sold (kg)			
	Selling price per kg on farm-gate, Birr			

3.2. Meat processing.

182. Do you have any experience in processing meat? 1. Yes 2. No
182.1. If your answer is yes, what are the processed products?
1. Salted meat 2. Air dried meat 3. Others
183. If yes, what is the purpose of processing meat?
1. It is de3manded by the market.
2. In order to protect spoilage by microorganisms.
3. Others----------
184. Which type of processed meat is good?

1. Salted meat 2. Air-dried meat 3. Others ----------

185. What are the processing materials used?
1.
2.
3.

186. What are the major times in which meat is processed?
1. During wet season 2. During dry season 3. When there is excess meat.
4. When ever we are in need of processed meat for our consumption.
5. When there is a high market demand.

3.3. Meat and live animals marketing.

187. What should be more important to be preferred by the live animals market?
1. Fattened animals 2. Only big weight 3. Lean meat 4. Others

188. What was the price of fattened animals?
Minimum ------- Birr. Maximum ------- Birr.

189. Do you have an experience of selling meat? 1. Yes 2. No

190. If yes, where do you sell?
1. from farm gate 2. Market place 3. Others ----------

191. If yes, which market is more attractive for meat price?
1. Farm gate 2. Local kebele market 3. Woreda town main market
4. Gondar town market 5. We sell to Sudan traders.

192. What was your marketing place for selling your fattening animals?
1. Farm gate 2. Local kebele market 3. Woreda town main market
4. Gondar town market 5. We sell to Sudan traders.

193. Which market is more attractive for price of live animals?
1. Farm gate 2. Local kebele market 3. Woreda town main market
4. Gondar town market 5. We sell to Sudan traders.

194. How many Kms you went to sell your fattened animals? -------- Km.

195. Did you consider weight loss while you were trekking to the market?
1. Yes 2. No

195.1. If yes, how much? ------ Kg.

196. How do you alleviate this kind of problems?
1.
2.
3.

197. Did you take your processing meat to the market? 1. Yes 2. No

198. If the answer is yes, what are they?
1. Salted meat 2. Air-dried meat 3. Others ----------

199. Where do you take these products to sell?
1. Farm gate 2. Local kebele market 3. Woreda town main market
4. Gondar town market 5. We sell to Sudan traders.

200. What was the price of the commodity?

#	Commodity	unit	Price of the products(Birr)		Major buyers	
			Wet season	Dry season	Wet season	Dry season
1	Live animals					
	Fattened ox					
	Fattened steer					
	Non fattened ox					
	Non fattened steer					

2	Raw meat					
3	Salted meat					
4	Air dried meat					
5	Others					

Codes: Major buyers: 1. Rural consumers 2. Town consumers 3. Traders 4. Others --------

201. What are the major problems existed in the area? Rank them.

9. BIBLOGRAPHY

The author was born in west Gojjam Zone, particularly at Yilmana Densa Woreda (Addet) in 1962 E.C. And he grew up and attended his elementary and high school education at Aste Serste Dengil and Tana Hiqe School, respectively, in Bahir Dar town. And then, he joined the former Alemaya University of Agriculture and currently known as Harromaya University in 1979 E.C. and he graduated in the department of amimal science in 1982 E.C. After he graduated, he was employed in the MOA at the beginning of 1983 E.C. Following this year, he served in Southern and Amhara region at woreda and zonal level with different status (expert, team leader, vice head and head of Agricultural office) until he came to Hawassa university for postgraduate study.

Now a days, the author is married and have one little girl.